DOCUMENT RESUME

ED 164 314	SE 025 492
AUTHOR	Long, John Wingo, Ed.; And Others
TITLE	Seafood Products Course Lecture Guide.
INSTITUTION	Virginia Polytechnic Inst., Blacksburg. Extension Div.
REPORT NO	VPI-SG-78-01
PUB DATE	78
NOTE	180p.
AVAILABLE FROM	Virginia Polytechnic Inst. & State Univ., Sea Grant, Extension Division, Blacksburg, VA 24061 ($4.00)
EDRS PRICE	MF-$0.83 HC-$10.03 Plus Postage.
DESCRIPTORS	Animal Science; Biology; *Consumer Education; Cooking Instruction; Environmental Education; Foods Instruction; *Home Economics Education; *Marine Biology; Science Education; *Seafood; *Teaching Guides; Zoology

ABSTRACT

This consumer's guide offers practical information about the characteristics and uses of seafoods. It covers both finfish and shellfish, including crabs, lobsters, shrimp, oysters, clams, and scallops. It describes the characteristics, important species, fishing methods, market forms, and consumer inspection tips. It also gives such information as how much to buy, and handling and storing tips. This guide is intended to be useful as a seafood products program and teaching guide for extension agents, home demonstration club leaders, and home economics teachers; as a practical guide to the selection and preparation of seafoods for consumers; and as a general sourcebook on seafood products for laymen. (BB)

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Seafood Products

Course Lecture Guide

Sea Grant
Extension Division
Virginia Polytechnic Institute
and State University
Blacksburg, Virginia 24061

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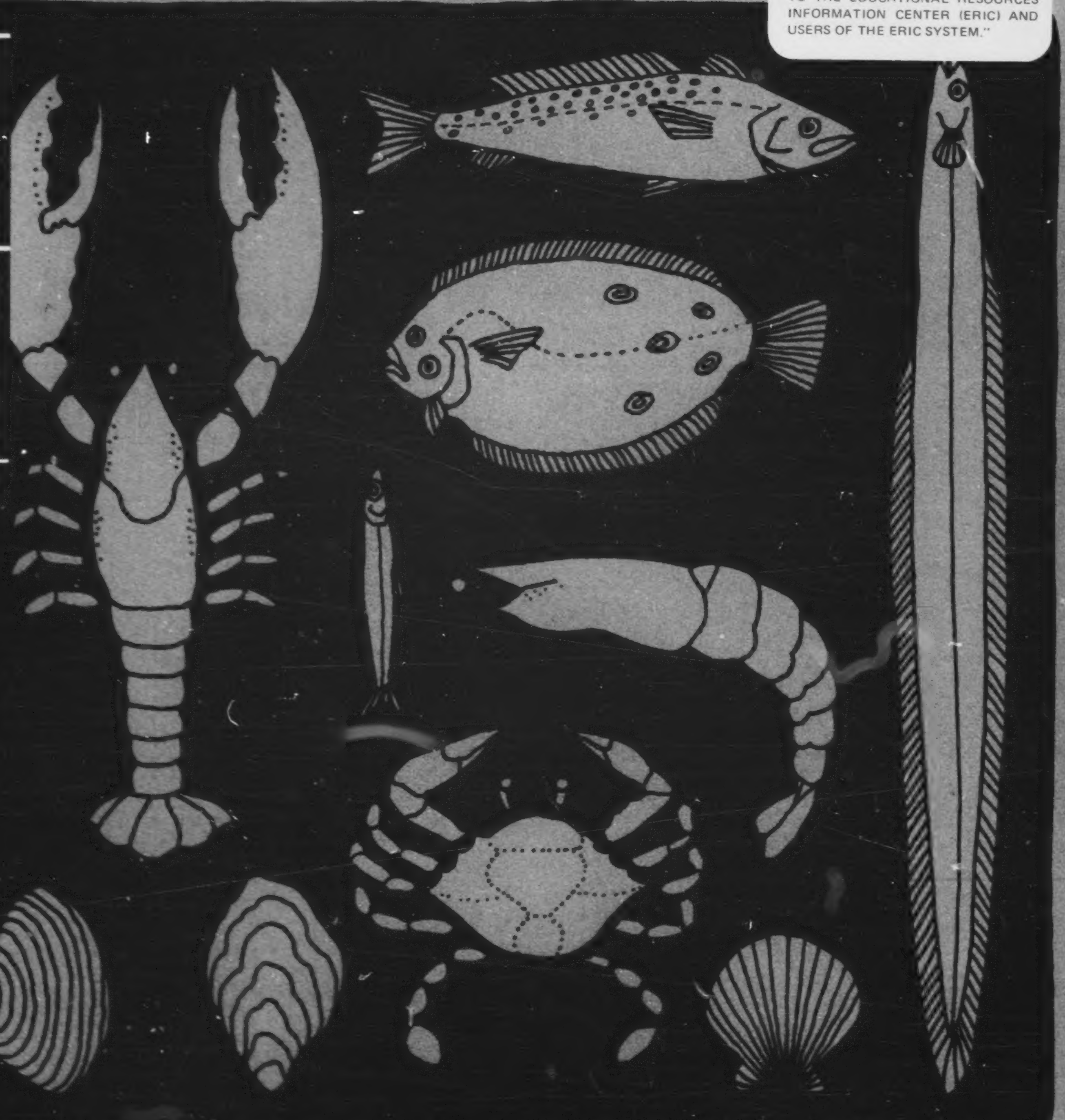

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SEAFOOD PRODUCTS COURSE LECTURE GUIDE

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INTRODUCTION

Seafood products are a readily available and highly nutritional source of food in this country, yet these valuable resources have not reached their full potential among consumers. We feel that part of the problem lies in the lack of practical information about the characteristics and uses of seafoods.

This publication is intended to fill the void in several ways: as a seafood products program and teaching guide for extension agents, home demonstration club leaders, and home economics teachers; as a practical guide to the selection and preparation of seafoods for consumers; and as a general sourcebook on seafood products for laymen.

The information contained in the manual should be sufficient for a discussion leader or lecturer to present informative general programs about seafoods. A demonstration of the shucking, picking, filleting and other preparations of the various species would require the assistance of a proficient individual.

PART I: SHELLFISH

I-A: CRABS

Characteristics

Crabs are broad bodied, flattened crustaceans. They are recognized by their hard shells or exoskeletons, and four pairs of jointed walking legs in addition to claws. Most species are found in the sea, from the tide line out to great depths.

There are more than 4,500 species of crabs in the world, ranging in breadth from fractions of an inch to nearly twelve feet. Most are scavengers, though some capture live prey and others filter plankton from sea water.

The female carries her eggs in a mass, called a "sponge", on her underside. In about two weeks they hatch into free-swimming larvae called zoea. After several moltings, zoea become adults.

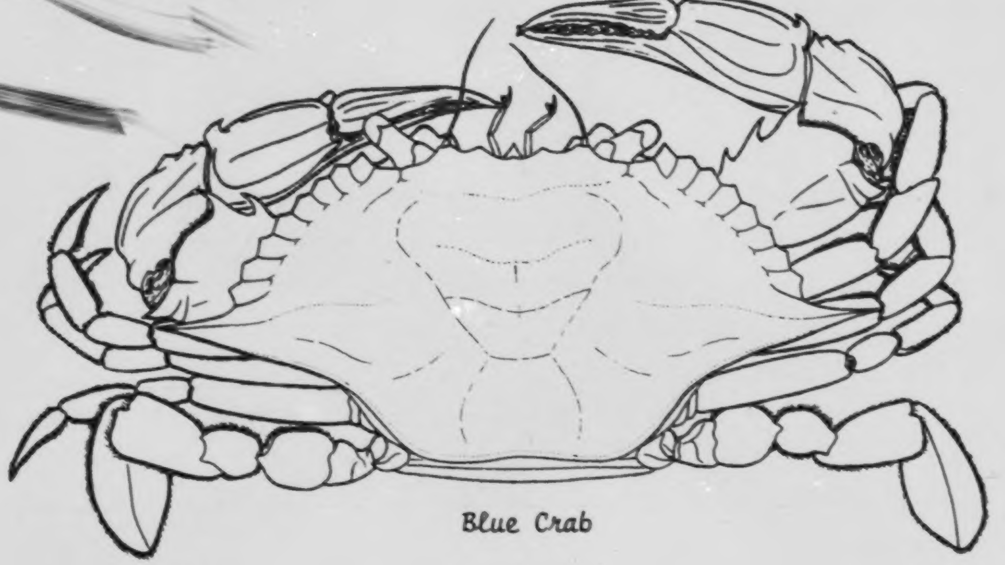
Crabs generally live three to four years. They may lose one or more legs during their lives, and are able to grow new ones through a regeneration process.

Hard and soft crabs: the molting process

Periodically, in order to grow, a crab sheds its external armor or shell. This process is called molting. Before the molt starts, a new, soft exoskeleton forms inside the old, and the crab backs out of the old shell as it loosens. The new shell is soft and elastic, allowing the crab to grow. It is particularly vulnerable to attack during the soft-shell stage and seeks refuge in a secluded spot until the new shell hardens.

Soft shell crabs are taken during the late spring, summer, and early fall, as the molting process takes place only during warm months. The crab houses which handle these crabs are known in the trade as "shanties" or "shedding houses".

Important Species



Blue Crab

Blue Crab: The blue crab (*Callinectes sapidus*) is found on the Atlantic coast from Massachusetts Bay to South America. When fully grown, it averages 5 to 7 inches across the back of the shell, which is brownish green or dark green. The underside of the body and the legs are white, while the tops of the claws show varying amounts of blue. The tips of the female's claws are bright red.

The blue crab is the most important commercial species. The Chesapeake Bay provides about half the weight and value of United States landings.

Blue crab meat is available in several different forms:

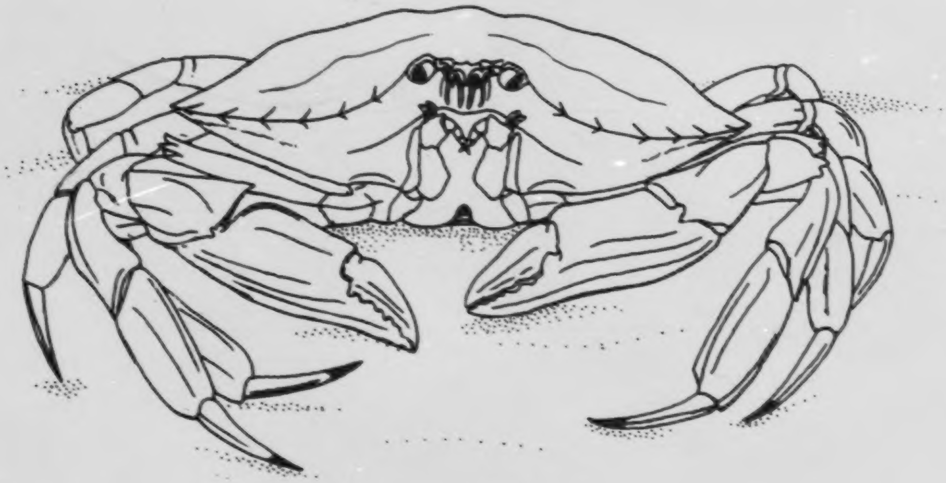
a. Lump (back fin) - the highest quality crab meat, includes all meat from the body portion adjacent to the back fin appendage which substantially remains in sizeable lumps.

b. Flake (regular or white) - all meat from the body portion except the lump.

c. Claw - all meat from the claw appendages.

d. Mixed White (special) - all meat from the body part of the crab in normal proportions (consists of all the lump and flake meat).

e. Deluxe - This term is not an official market standard. Consequently, the type of parts and quality may vary considerably among wholesalers and retailers. The term is usually employed to define a variable mixture of lump and flake.

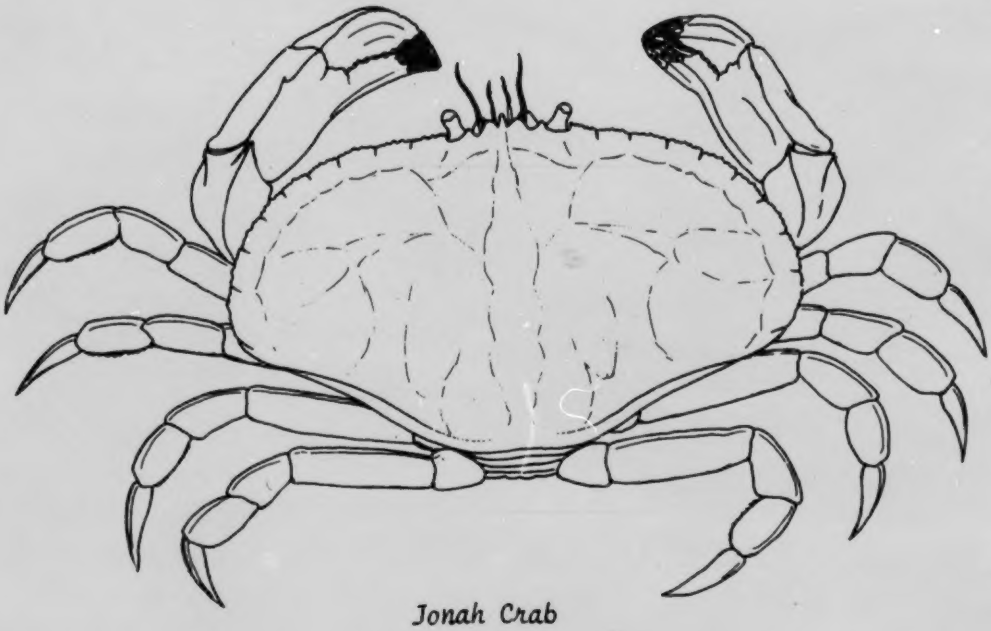


Rock Crab

Rock Crab: The rock crab (*Cancer irroratus*) is found on the North Atlantic coast from Nova Scotia to the South Atlantic states. It has a smooth, oval, ivory-colored carapace, with purple or crimson spots. Though moderate in size (5 inches, 7 ounces), its meat is equal to the blue crab in quantity and flavor.

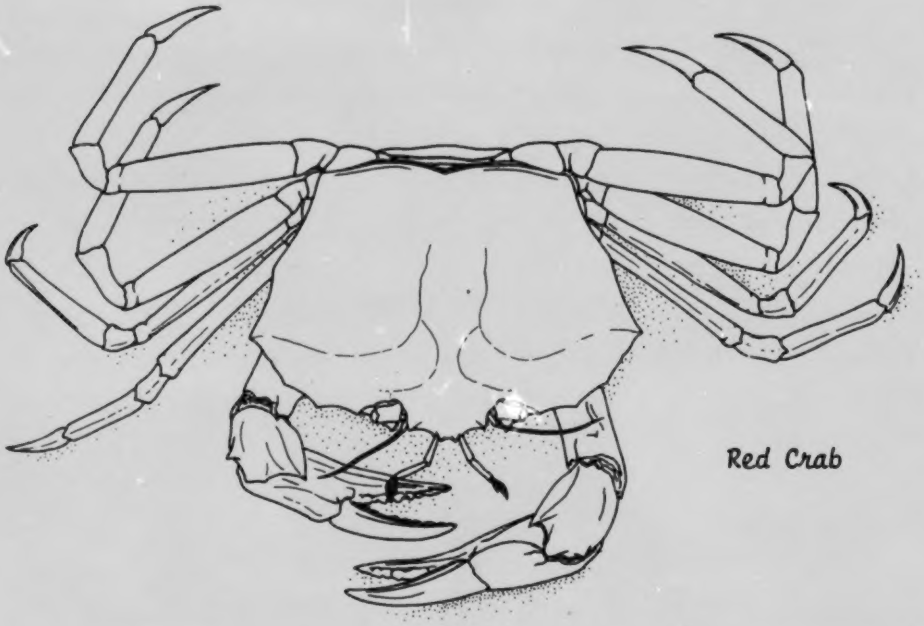
Brownish in color, the meat is picked from both body and claws and is marketed as one grade. Though this species is abundant, it is not fished extensively. It has great future potential.

Dungeness Crab: The dungeness crab (*Cancer magister*) is the common crab of the Pacific coast from Alaska to southern California. At 9 inches in breadth, it is one of the largest edible crabs in the United States. It is light reddish-brown on the back with a pattern of lighter streaks and spots. It is marketed whole as cooked "dressed" crab, or the cooked meat is sold fresh, frozen, or canned. Fresh cooked meat is picked from both body and claws and packed as one grade. Body meat is white, while claw and leg meat is reddish.



Jonah Crab

Jonah Crab: The jonah crab (*Cancer borealis*) resembles the rock crab but is larger with a rougher, brick red carapace. It is found in the same areas as the rock crab, but usually in deeper water. Its flavor is excellent, but it has never been an important article of commerce because of its limited distribution.



Red Crab

Red Crab: The red crab (*Geryon quinquedens*) is found off the east coast of the United States from Nova Scotia southward to Cuba. The color is usually dark red, the legs are long and slender, and the body is somewhat square. This species reaches a width of 7 inches and may weigh more than 2.5 pounds. It may yield as much as 23 percent meat, which is approximately twice the yield of the blue crab. The commercial potential of this crab has not yet been realized, though seafood processors in several states have expressed interest in this new seafood resource.

Stone Crab: The stone crab (*Menippe mercenaria*) ranges from North Carolina to the Gulf of Mexico and to the Bahamas. The oval carapace is dark purplish-blue in young crabs, brownish-red with flecks of gray in adults. The comparatively large claws are smooth, and banded with red and yellow. The principal fisheries are in Charleston, South Carolina, and Key West, Florida, but are not extensive because of the scarcity of this crustacean. Most meat comes from the claws, and compares favorably in flavor with the blue crab.

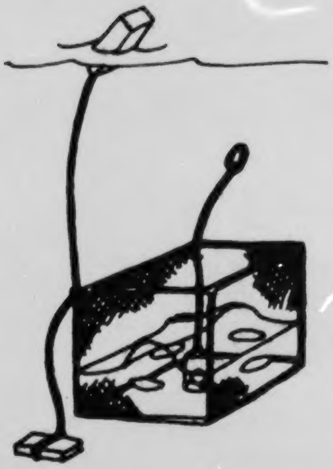
King Crab: The king crab (*Paralithodes camtschatica*) is found in the cold waters of the North Pacific Ocean, the Okhotsk Sea, and the Berring Sea. One of Alaska's most valuable resources, king crabs have several distinguishing characteristics: a rough, heavy shell; reddish carapace and legs, covered with spines; a last pair of legs that is small and hidden; and, above all, great size. These are the largest of crabs, averaging 12 pounds, with a tip to tip span of 4 feet. Much larger individuals have been captured. The prime meat is in the claws, legs, and shoulders. It is available in the shell, fresh packed, frozen, or canned.

Fishing Methods.

Soft shell crabs are usually caught in shallow waters, where they hide at molting time, by dip nets, push nets, or scrapes. A dip net is simply a net on a hoop at the end of a long handle, used by the crabber from his boat. A push net is similar, but larger, and the hoop is flattened on the side opposite the handle. This net is pushed along the bottom by a crabber wading in the shallow water. A scrape is a triangular iron frame two to five feet wide, with a cotton mesh bag about six feet long extending behind. It is dragged along the bottom by small boats.

Soft shell crabs are either caught in that condition or are obtained by holding "peelers", crabs about to shed, until they molt. Crabbers recognize peelers by a pink line that appears on the fourth pair of legs just before molting. These crabs are kept alive in boxes and floats until they "shed out". The majority of soft crabs are obtained in this manner.

Hard shell crabs are caught with scrapes, dredges, and trotlines. A dredge is a larger, modified version of the scrape explained above. A trotline is a rope, from 1/4 to one mile long, with a chain anchor at each end. A buoy is also attached to show the location and the owner. The line is baited about every 18 inches with salt fish or cheap meat. A boat moves along the line and lifts it by means of a roller. Crabs are taken off with a dip net.



Atlantic Hard Crab Pot

Crabs are also caught by the crab pot method. A box about two feet square consisting of wire mesh on a rigid metal frame is used. There are two chambers, and the lower one is baited. The crab swims upwards after grasping at the bait, enters the upper chamber and is imprisoned. A crabber may set 35 to 50 crab pots and fish them from a small boat.

Market Forms

Crabs are available in several forms: live, cooked in the shell, cooked and frozen, picked cooked meat, or canned meat. Some hard shell crabs are shipped alive in barrels of ice and sold within comparatively short distances from the point of capture. Soft crabs are always shipped alive, carefully sorted and specially packed in wooden trays lined with seaweed. With careful handling, they can be shipped hundreds of miles.

The most common market form of crabs is the picked cooked meat. It is picked from hard shell crabs which have been steamed, and then is shipped on ice or canned. Meat from the blue, dungeness, king, and rock crabs is available in cans ranging from 3 1/4 to 17 ounces.

Pasteurized crab meat is available in some areas. It is produced by heating meat packed in cans to an internal temperature of approximately 185°F. Since the meat is not given a full heat treatment, it must be stored under refrigeration between 32-36°F. When properly refrigerated, a shelf-life of 6 months is usually expected. Sometimes the pasteurized meat may have a bluish or blue-gray color. This is caused by a processing temperature over 190°F. The over-processed product is safe to consume and usually does not contain off-flavor or odors.

Consumer Inspection

Fresh crabs bought in the shell should be alive; that is, they should move their legs when touched. Crab shells should not be slippery. Cooked crabs in the shell should be bright red and should have no disagreeable odor. Odor can be easily detected by slightly lifting the lid under the body section of the crab. Frozen crab should be hard-frozen when bought, with no odor.

Picking the Meat from Blue Crabs (Cooked in the Shell)

With the left hand, grasp the body of the crab with the large claws to the right. Break off the large claws. Pull off the top shell with the right hand. Cut or break off the legs. Scrape off the gills and remove the digestive and other organs located in the center part of the body. Slice off the top of the right side of the inner skeleton, beginning near the front. Remove any meat on this slice; then starting with the right back fin pocket, remove the meat from the lower part with a U-shaped motion of the knife. Remove the meat from the other pockets by inserting the knife underneath and prying upward. Cut off the top from the left side of the inner skeleton and remove the meat in the same manner as for the right side.

Color Film, "Picking the Blue Crab", Available

Sea Grant at Virginia Tech has developed an 8 minute, 16 mm color film with narration on the correct method for picking the blue crab. Instruction is given on removing the backfin (lump), flake and claw meat for both right and left-handed individuals. The film can be used as a training aid during or prior to demonstration and practice.

For film loan information call or write: Film Library, Learning Resources, Patton Hall, Blacksburg, VA 24061. Telephone (703) 951-6718. When writing for a film loan, please give a minimum of 30 days notice.

For film purchase information, call or write: Extension Division, Sea Grant Program, Food Science and Technology, VPI&SU, Blacksburg, Virginia, 24061. Phone (703) 951-6965. Present cost (March 1977) is $75.00.

When ordering a film for loan, please use the form that follows.

Send to: Film Librarian, Learnin Resources, Patton Hall, VPI&SU, Blacksburg, Virginia 24061.

Please send the film "Picking the Blue Crab" on the indicated date(s).

Name ____________________

Address ____________________

____

City ____________ State ____________ Zip ________

Telephone Number ____________________

Preferred dates ____________ (and,or) ____________

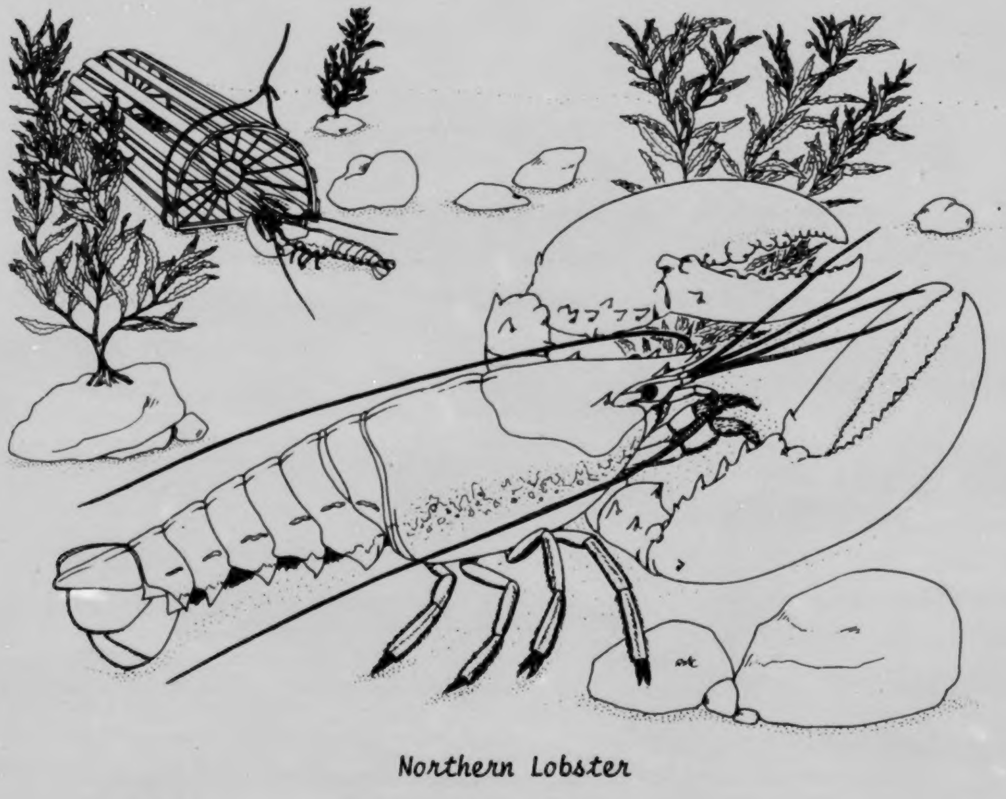
Alternate dates ____________ (and,or) ____________
(if possible)

(The film is loaned by VPI&SU for a one to three day period.)

I-B: LOBSTERS

Characteristics

There are several families and more than 200 species of lobsters. They are crustaceans that live on rocky, sandy, or muddy bottoms from the shoreline to the continental shelf. Lobsters live singly in crevices and burrows, and are most active at night, scavenging for mollusks, sea worms, small fishes, and some plants. They have two claws, a larger one for crushing and a smaller one for cutting, and are capable of swimming backwards swiftly by snapping their abdomens down and under. It is the large muscle of this abdomen that is prized for its flavor. Lobsters' colors range from light green to deep blue.



Northern Lobster

Important Species

Northern Lobster: The northern or true lobster (*Homarus americanus*) is found in the waters of Great Britain, Canada, New England, and the middle Atlantic states. Primary production is centered in Maine, and this species is thus often called the Maine lobster. The northern lobster may grow to 25 pounds, though market lobsters average about 1-3 pounds.

Spiny Lobster: Spiny or rock lobsters (*Panulirus argus*) are actually sea crawfish, though they are related to lobsters. There are several distinct differences: the spiny lobster does not have the large heavy claws of the true lobster; it is covered with spines on both body and legs; and it has long slender antennae. It is caught off the coasts of Florida, and a similar species (*Panulirus interruptus*) is found off the coast of California.

Fishing Methods

Most lobsters are caught in traps called lobster pots. These are oblong boxes made of wood laths spaced to allow under-sized lobsters to escape. The ends of the pots have netting arranged in a funnel shape which permits lobsters to enter but makes it difficult for them to escape. The lobster pots are baited with fish, weighted, and lowered to the bottom. They are marked with a buoy. Some spiny lobsters are fished from small skiffs with the help of a dip net.

Since most lobsters are sold alive, the catch is often held in underwater cages called holding pounds until marketing. They are shipped alive in barrels, packed in layers of seaweed with surrounding ice.

Market Forms

Lobster may be found in many forms: live, whole cooked in the shell, frozen raw, boiled and frozen, fresh cooked meat, frozen cooked meat, and canned cooked meat. The meat comes from the claws and tail, except spiny lobsters which have no claws. Spiny lobster is often marketed as rock lobster and is usually the source of "lobster tails" available in stores and restaurants.

It has been reported that lobsters frozen raw retain their quality better than those which have been boiled. The deterioration of meat which has been cooked results in a toughening and loss of flavor over long storage. However, frozen whole lobsters suffer considerable breakage because the legs snap off easily unless they are handled with considerable care. In order to reduce breakage, lobsters are usually packed in cartons before they are frozen. Frozen lobsters are sometimes packed in individual waxed cartons.

The cooked meat of the lobster, picked from the shell, is marketed fresh, frozen, and canned. Frozen lobster meat can be purchased in 6, 14, and 16 ounce cans, or in waxed cardboard cartons.

Consumer Inspection

When purchased, lobsters should be alive. If alive, they will show movement in the legs when touched; and their tails should curl under the body and not hang down when they are picked up.

Though the shells of lobsters and spiny lobsters may vary in color, they rapidly change to "lobster red" during cooking. Whole lobsters cooked in the shell should therefore be bright red in color and have a fresh "seashore" odor, not disagreeable. Frozen lobster and lobster tails should be hard frozen and have no odor.

Lobster in the shell varies in weight between 3/4 and 3 or more pounds, and is graded in four sizes: chickens, 1 pound average; quarters, 1 1/4 pounds average; halves, 1 1/2 pounds average; large, 1 3/4 - 3 pounds; and jumbos, over 3 pounds. Lobster tails usually run from 4 ounces to 1 pound each. A one pound lobster will yield 2/3 cup of flaked, cooked meat.

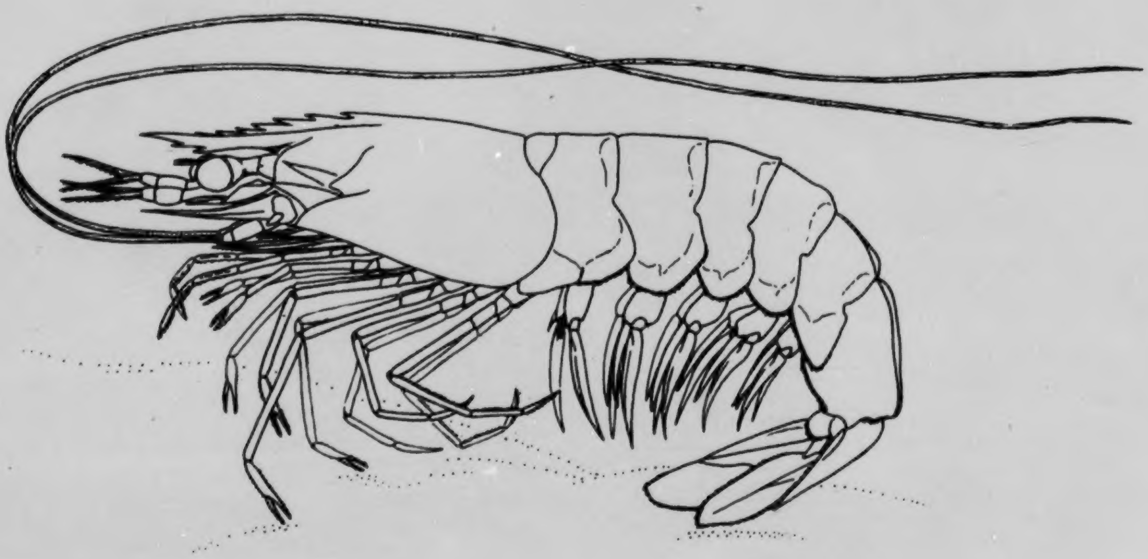
Live lobsters missing one claw are marketed as "pistols" Those missing both claws are marketed as "culls".

I-C: SHRIMP

Characteristics

There are several hundred species of shrimp. They range from less than an inch to nearly twelve inches in length. Larger shrimp are sometimes called prawns. Shrimp resemble crayfish, having segmented exoskeletons and stalked eyes. Like other crustaceans, they shed their shells and replace them with larger ones in order to grow.

Live shrimp come in a variety of pale colors, including pink, brown, white, and gray; but all turn pink with cooking. Because shrimp are one of the most popular of seafoods, they are among the most valuable marine resources of the United States. They are fished commercially in the Atlantic Coast from Virginia south to Brazil, and in the Gulf of Mexico.



White Shrimp

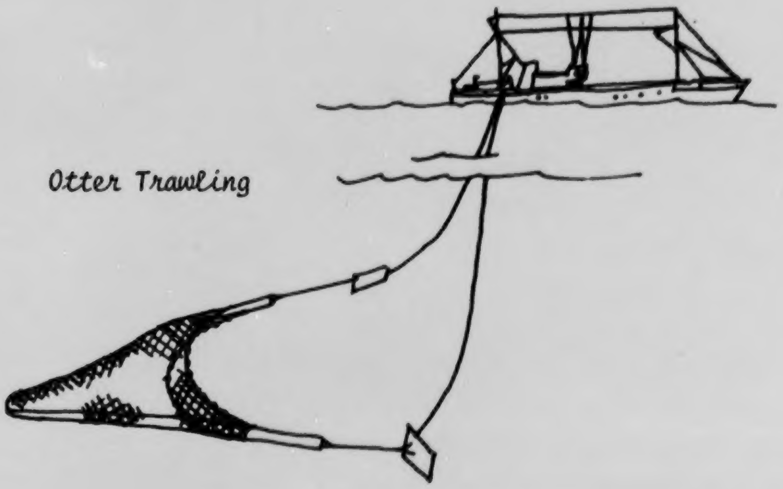
Important Species

White Shrimp: The white shrimp (*Penaeus setiferus*) is the common greenish-gray shrimp found in the shallow waters of bays and other inshore areas. The white shrimp fishery is centered in Louisiana. The white shrimp accounted for about 90 percent of shrimp landings prior to 1948, but has now been overtaken by the other varieties.

Brown Shrimp and Pink Shrimp: The brown (*Penaeus aztecus*) and the pink (*Penaeus duoarum*) shrimp are often called "grooved shrimp" and are caught in the Gulf of Mexico off Texas, Alabama, Florida, and Mexico. Much larger quantities are caught at night than in the daytime. As the names imply, the brown shrimp is brownish-red in its raw state, and the pink shrimp pink or coral colored.

Fishing Methods

Although some shrimp are caught in nets and baited pots, most are collected by an otter trawl, which is towed slowly along the ocean floor by a boat. The trawl is a large funnel-shaped bag, sometimes 100 feet across, with boards on the sides to hold it open. It is hoisted aboard the pulling vessel at intervals and the shrimp emptied on deck. Often the shrimp are deheaded on board, and then stored in ice.



Otter Trawling

Market Forms

Shrimp are available in most areas of the United States either raw or cooked, peeled or unpeeled, and fresh or frozen. Near production points, they may be purchased with heads, though usually they are found already deheaded. Peeled meats of shrimp, individually quick frozen, may be bought in polybags or rigid plastic containers in a variety of sizes and weights. Shrimp may also be bought by the pound or in convenient, shelf-ready cans. They are also marketed as broken, imperfect pieces for use in salads or mixed dishes where shape is not important. Shrimp are termed "whole" if they consist of five or more segments of shrimp flesh.

Breaded shrimp are also popular. Frozen raw breaded shrimp are made from whole, clean, headless shrimp which have been peeled and deveined. The shrimp are coated with a wholesome batter and/or breading. Many consumers are unaware that frozen raw breaded shrimp are available with different amounts of breading material. "Regular Breaded" contain a minimum of 50 percent shrimp material. "Lightly-Breaded" contain a minimum of 65 percent shrimp material.

Two types of breaded shrimp are marketed: "Breaded Fantail Shrimp" and "Breaded Round Shrimp". Both types are available in three forms which vary in the amount of tail fin and shell segments retained. Breaded shrimp are highly suitable for inspection and grading, but not all these products on the market are inspected or graded. (See Part III-B for information on grading and inspection of seafood products).

Consumer Inspection

Fresh shrimp should have a mild odor and firm meat. Meat and shells should not be slippery. The color of the shell may be grayish green, pinkish tan, or light pink, but there is little difference in appearance or flavor when cooked. Cooked shrimp have red shells, and the meat also takes on a reddish tint, possibly with some dark-red spots.

Shrimp are customarily sold according to size or grade, based on the number of headsoff shrimp to the pound. The count or number designation may also be described by such general terms as jumbo, extra large, large, medium, and small. The largest size or grade runs 15 or fewer to the pound;

the smallest size runs 60 or more to the pound. Today, however, most shrimp are sold by count ranges of 5 rather than grade. For example: 16-20, 21-25, and 26-30. The package usually contains the count for the consumer's information.

Since all species may be used interchangeable in cooking, the size of the shrimp assumes more importance if the cost and time required to prepare a recipe are taken into consideration. Jumbo shrimp generally cost the most, but take less time to peel and devein; small shrimp cost the least but take longer to prepare. They have the same fine flavor and food value.

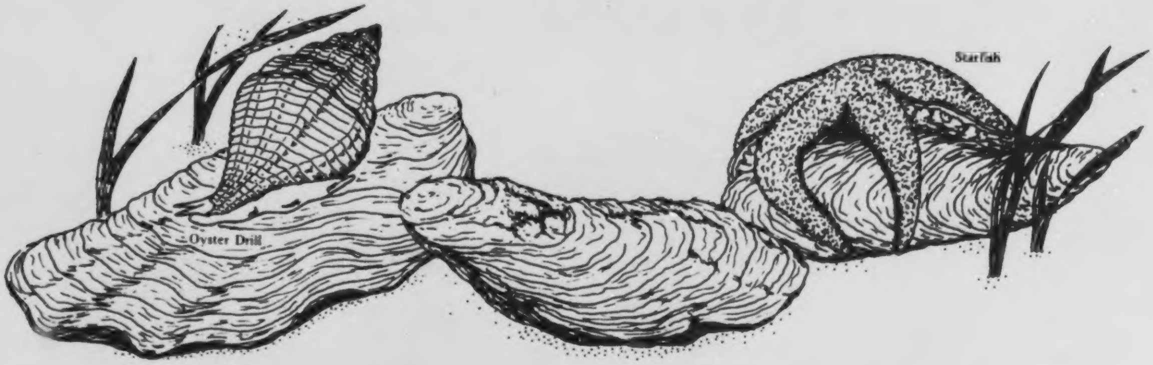
I-D: OYSTERS

Characteristics

Oyster is the name for over a hundred species of bivalved mollusks. They occur chiefly between tidal levels or in shallow, slightly brackish water along the coasts of temperate and tropical areas. Sedentary creatures, they attach themselves by a limy secretion to any support and, once located, never voluntarily move again. They feed on minute organisms, both plant and animal, which they filter from the water. They have many natural enemies, including oyster drills and starfish.

True oysters are distinguished by dissimilar lower and upper shells or valves, which are hinged together by a complex elastic ligament. The upper shell is normally flat, while the lower is concave, providing space for the body of the oyster. The two valves fit together to form a water-tight seal when the oyster closes. Near the center of the oyster's body is an adductor muscle, attached to both valves, which controls the opening and closing of the shell.

Important Species



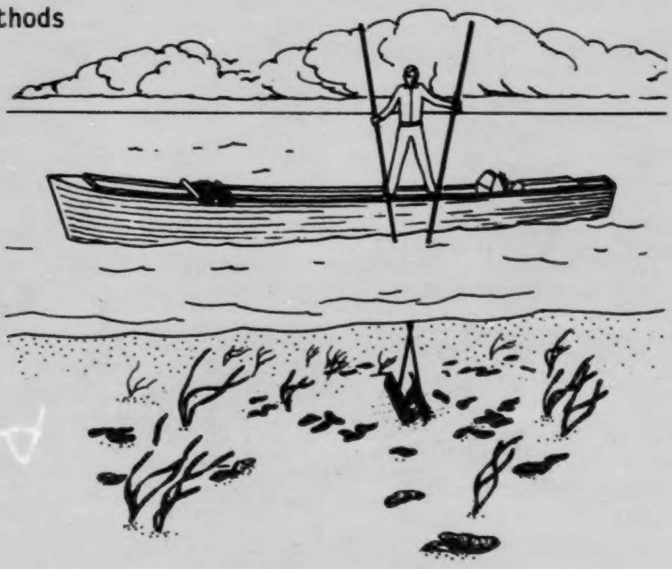
Eastern Oysters and Enemies

Eastern, Atlantic, or American Oyster: The Eastern oyster (*Crassostrea virginica*) is found along the North Atlantic seaboard from the Gulf of St. Lawrence to the Gulf of Mexico. Commercially, it is by far the most important oyster, accounting for approximately 85 percent of the total production in the U.S.

Pacific, or Pacific King Oyster: The Pacific oyster (*Crassostrea gigas*), which is now the basis of the West Coast industry, was imported from Japan for trial plantings after experimental plantings of the Eastern oyster failed. It is grown in coastal waters from Alaska to Northern California, with the biggest production areas in the state of Washington. The Pacific oyster comprises about 15 percent of U.S. production.

Western or Olympia Oyster: The Western oyster (*Ostrea lurida*) is native to the Pacific Coast. It was of commercial importance until about the turn of the century; but the yield of this species has declined because of over-exploitation, predators, pollution, and increased costs of production. Some are still available, and it is hoped that through conservation methods the cultivation of this species can be increased.

Fishing Methods



Man tonging for oysters

The oyster was one of the first seafoods utilized by man. It was easily harvested by hand during low tide. Some oysters are still gathered in this manner, but many more are caught by boatman with "tongs", long handled rakes joined like the blades of shears. The most economical method of harvesting oysters, which now accounts for two-thirds of the harvest, is power dredging. The oyster dredge is a metal frame with a toothed bar across the front which dislodges the oysters and rolls them back into a chain mesh bag until they can be lifted to the boat.

Sea farming--or mariculture--programs produce most commercial oysters. A likely area is strewn with oyster shells, or other artificial attachment material, and young oysters ("spat") are introduced to the area and attach themselves to the shells. When the spat reach a breadth of about an inch, they are taken up as "seed" oysters and introduced into commercial beds.

This mariculture method was first experimented with by the Romans. The Virginia Institute of Marine Science (VIMS) and other agencies are presently studying ways of producing "spat" in laboratories or other non-natural habitats. The James River in Virginia is one of the major producers of seed oysters in the U.S.

Market Forms

Oysters are available in several forms: live in the shell, fresh shucked, frozen, and canned. Oysters in the shell have been washed, chilled, and sometimes chlorinated by the processor. They are generally sold by the dozen, and are served in restaurants as "oysters on the half shell".

Many more oysters are "shucked" or removed from the shell before shipment. The meats are then washed in a "bubbler" which churns the meats in fresh water by means of air blown in from the bottom of the tank. This agitation dislodges sand and silt from within the oysters. Meats are then graded for size, sealed in glass or metal containers, and shipped fresh in crushed ice. They are available in half pint or pint and 8, 12, and 16 ounce containers.

In recent years, shucked oysters have also been quick frozen, a process which makes them available all year. Fresh shucked oysters are breaded, packed into cartons, and frozen. Individual meats may be removed as desired. Oysters are also diced, mixed with other ingredients, and frozen for oyster stew. Or, they may be found among the precooked foods in the market. Breaded, deep fat-fried, cartoned, and frozen, they need only reheating in the oven.

Canned whole oysters and oyster stew are prepared from steam-opened oysters. These have been passed through a steam retort for about ten minutes, which opens the shell for easy removal. They are then canned and sterilized in the retort. Ready-made oyster stew, needing only reheating for table use, is available, as are oysters smoked and packed with vegetable oil in glass or metal containers.

Consumer Inspection

Shell oysters: Shell oysters must be alive when purchased. When alive, they have a tightly closed shell. Gaping shells that do not close when tapped indicate that the oysters are dead or nearly so and therefore not fit for consumption.

Shucked oysters: Fresh shucked oysters should be plump and should have a natural creamy color (some oysters have a natural tan, brown, or black film over the mantle). The liquid should be clear or slightly opalescent, free from shell particles, with no sour smell; and there should not be more than 10 percent liquid by weight in the original container. The oysters should have a mild odor.

Eastern oysters are generally packed and graded according to the number of meats to the gallon: very small, over 500; small or standards, 301 to 500; select or medium, 211 to 300; extra select or large, 160 to 210; and counts or extra large, under 160. Grade prices increase with size.

Color variations: The usual color of a normal fresh raw shucked oyster is variously described as creamy, gray, brownish, pale yellow, or some combination of these. However, other colors may not indicate spoilage.

If the oyster is green it is still probably fresh and good to eat. In fact, in Europe, gourmets actually prefer green oysters to cream-colored ones, as green oysters are considered more flavorful.

The green color may be chlorophyll from green plants the oyster had been eating before being caught. Or it may be copper, if the oyster came from waters containing high concentrations of copper.

If the oyster is red, or if the "liquor" in which the oyster is packed is red, the red may be a dinoflagellate or algae which has been in the oyster's food. The red pigment is water soluble, and appears when the dinoflagellate-eating oyster is cut during shucking or frozen after shucking.

This red pigment will be destroyed when the oyster is heated to only 120°F for a few minutes. Both the Food and Drug Administration and the U.S. Army Quartermaster Corps certify that this red color is a seasonal occurrence--late fall and early winter--and is not a health hazard. It has nothing to do with the "red tide" which occurs occasionally in Florida and in North Atlantic waters; red tide has never been reported in the Middle Atlantic.

Several Virginia oyster processors have prepared stick-on labels for their oyster packages, to assure the consumer that the red color is neither abnormal nor a health hazard.

If the oyster has brown spots, they are caused by a normal biochemical reaction that sometimes develops in southern oysters.

Sometimes in the past oysters or the oyster liquor might have been pink, a color caused by yeast growth; such a color indicated that the oyster was subjected to unsanitary conditions either on the harvesting boat or in the processing plant. Because of refrigeration on boats, and inspection of both boats and plants, this problem almost never occurs any more.

The pink color, however, might more likely be caused by a strange tiny animal, also a seafood in its own right--if you get enough of them! This is the pea crab, which lives in the gills of the oyster and feeds on the same foods that the oyster is filtering for itself.

The color comes from a pigment in the pea crab's eggs, but pea crabs apparently do no harm to the oyster, either in its living habits or in its edibility and tastiness, even though one scientist found 262 pea crabs living in one oyster!

The tiny crabs, less than one millimeter in size, invade the mantle cavity of the oyster, usually in late summer or fall. Their growth slows during cold weather--when oysters are most harvestable--and does not begin again until spring and warm weather. Male pea crabs usually live only a year or less; females may live two or three years.

If you should be lucky enough to acquire oysters with pea crabs, be sure to save and eat both, as both are tasty and nourishing sea foods.

The "R" Rule

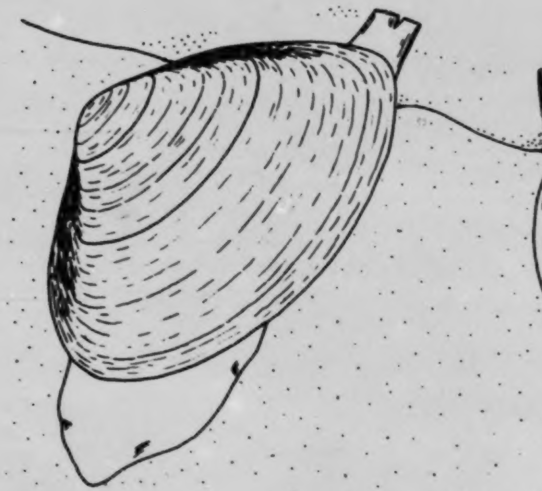
There is a common belief that oysters should not be eaten in months whose names do not contain the letter "r". This rule is not based on fact, however, as oysters can be, and are eaten at any time of the year. Their transportation and storage during warm months do require special care, since oysters are highly perishable. Summer is also spawning time for most oysters, leaving them watery, with little flavor or consistency. But frozen and canned oysters are not affected, and there are localities in various states where good quality oysters are available throughout the year.

I-E: CLAMS

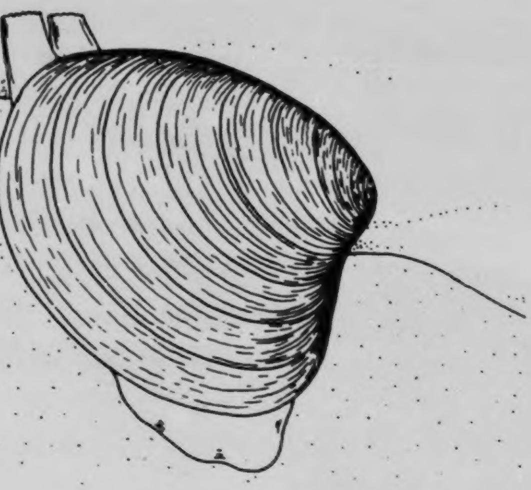
Characteristics

Clams are bivalved mollusks found in shallow waters all over the world. There are about 20,000 kinds of clams, all of which are edible; but only about 50 varieties are sufficiently large, tasty, and abundant to be commercially harvested. Depending on the species, they may be round, oval, elongated, or almost rectangular. They are found in both fresh and salt waters, usually buried in the mud or sand. All clams are vegetarians, straining algae from the water. They may live as long as 20 years, and reach maturity in 1 to 3 years. The giant tropical clam has been known to reach a length of 50 inches and a weight of 500 pounds.

Important Species



Surf Clam



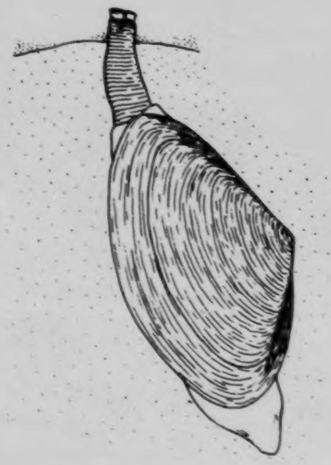
Ocean Quahog

Surf Clam: The surf clam (*Spisula solidissima*) is harvested in greater numbers than other species. It is also known as the skimmer, beach, giant, sea hen, or bar clam. Though abundant along Atlantic shores, it is not as valuable as the hard or soft-shell clam. The surf clam is smooth, tan colored, and oval. It reaches a length of 7 inches, and is found from Maine to South Carolina. Most canned clams are surf clams.

Ocean Quahogs: The ocean quahog (*Arctica islandica*) is also called "mahogany clam", "mahogany quahog", and "black quahog". This clam is 3 1/2 to 4 inches long and averages 1/2 pound. The ocean quahog has a hard shell that is extremely difficult to open with a knife, and steaming produces unpleasant effects on the meats. At present, this clam is under investigation to serve as a new resource, and may take the place of the diminishing surf clam.

Hard Clam: The hard clam (*Mercenaria mercenaria*) or hardshell clam, is commonly known as quahog in New England, where "clam" generally means the soft-shell variety. In the Middle and South Atlantic states, "clam" is the usual name for the hard clam. Hard clams are common from Cape Cod to Texas.

Soft-shell Clam: The soft-shell clam (*Mya arenaria*) is known in the Chesapeake Bay area as "manninose", "long clam", "long neck", "squirt clam", "sandgaper", or "old maid". These popular clams, unlike the hard and surf clams, have elongated shells that are very thin and brittle. Soft-shell clams cannot close tightly because their long necks extend beyond the shells. The southern limit of these clams is Maryland and some areas of northern Virginia.



Soft-shell Clam

Geoduck Clam: A Pacific coast clam, the geoduck (*Panope generosa*) has been recently utilized as a commercial resource. Geoducks are the most impressive clams in U.S. waters, weighing up to 13 pounds. The average clam weighs 3 pounds, and yields 1 1/2 pounds of meat. The geoduck is mostly neck. Even the mantle bulges out of the shell, which is always far too small to contain the entire clam. This clam burrows as deep as 4 feet into the sand or mud, and sends its siphon to the surface. Although some scientists disagree, latest opinion is that it takes approximately four years for a geoduck to reach maturity.

Fishing Methods

Clams were first harvested by aborigines who waded into shallow waters feeling for clams with their bare feet. This method is still used by individuals. On the Pacific Coast where outrunning tides leave large beaches exposed, clams are located by their siphon holes and dug by hand. In other areas, tongs similar to oyster tongs are used by boatmen. A "basket rake" is another device used, similar to tongs but with longer teeth and a wire mesh bag to catch and hold the clams as it is dragged along the bottom. Power driven dredges similar to oyster dredges are used in larger operations.

Market Forms

Clams are available alive in the shell, fresh shucked, frozen or canned. Shucked clams are the clam meats that have been removed from the shells; they are generally sold by the pint or quart. In recent years, shucked clams have been packaged and quick frozen, a process that makes them available all year. Depending on the variety, shucked clams may be sold as frozen breast steaks, neck steaks, minced meat, or chunks.

Hard, soft, razor, surf, and pismo clams are canned whole, minced, or as chowder, and are packed in various sizes of cans from 3 1/2 ounces to 4 pounds. Canned smoked chunks are also available. Clam juice, broth, and nectar are available canned or bottled.

Consumer Inspection

Clams in the shell are generally sold by the dozen or by the pound. They should be alive when bought. With hard clams, gaping shells that do not close when handled mean that the clams are dead and therefore no longer usable. In other varieties, the siphon or neck should twitch when touched.

The hard clam or quahog is marketed in Virginia in 3 to 6 size grades. However, most dealers use the following four-grade system: littlenecks, 1.5 to 2.25 inches; cherry stones, 2.25 to 3 inches; sharps 3 to 3.75 inches; chowders, 3.75 inches and larger. Sometimes you will hear the terms New York Nick or Philadelphia Nicks applied to hard clams. New York Nicks are those clams 2 inches or larger, whereas Philadelphia Nicks are less than 2 inches in size.

Shucked clams should be plump, with clear liquor, and free from shell particles. They are sold packed in metal containers or waxed cartons.

Preparation of Gathered Clams

If you decide to obtain the clams from the sea shore yourself, it is important that the clams be handled properly. First wash off all surface sand with sea water. Cover clams with clean sea water or 2 percent brine (1/3 cup salt to 1 gallon tap water) and let stand for 15 to 20 minutes to allow the clams to cleanse themselves of sand. (Salt is necessary if the clams are to open and discharge sand.) The sand will settle to the bottom of the container. Change the water and let stand a little while; repeat two or three times. This step is important if the clams are to be steamed or eaten from the shell. Clams can then be shucked.

Shucking Hard Clams

Wash the shelled clams thoroughly, discarding any broken-shell or dead clams. To open a hard clam, hold it in the palm of one hand with the shell's hinge against the palm. Insert a slender, strong, sharp knife between the halves of the shell and cut around the clam twisting the knife slightly to pry open the shell. Cut both muscles free from the two halves of the shell. If to be served on the half shell, remove only one-half of the shell. If to be used in another recipe, remove and rinse the meat. Since soft clams and surf clams do not have tight-fitting shells, they are easier to open.

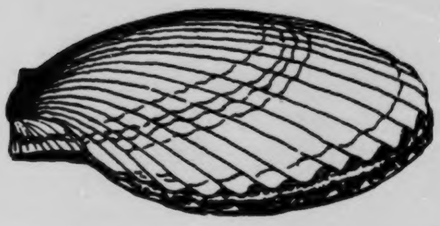
An alternate method is to place the shell clams, after washing, in a small quantity of boiling water. Cover and steam 5 to 10 minutes, or until they are partially open. Drain, remove, and wash the meat from the shells. Another method is to first freeze the clams and then wash them under tap water for several minutes. This removes the sand and causes the shells to open sufficiently wide to permit shucking. This method is probably the easiest and most accepted procedure.

I-F: SCALLOPS

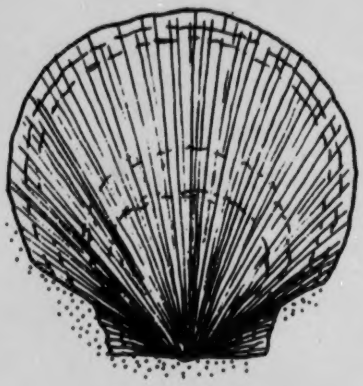
Characteristics

Scallops may be thought of as swimming clams. Like clams and oysters, they are bivalved mollusks, found in every sea. They usually rest on the bottom, but can swim rapidly by opening and closing their shells. The shells are rounded, with scalloped edges and radiating ribs. Sea scallops grow as large as 8 inches in diameter, while the smaller bay scallop is about half as large. Only the excellently flavored adductor muscle or "eye", which opens and closes the shell, is eaten by Americans. Europeans, on the other hand, eat the entire scallop. There are more than 40 species of scallops, but only two are of commercial importance.

Important Species



Bay Scallop



Sea Scallop

Bay Scallop: The common shallow-water scallop (*Pecten gibbus* or *P. irradians*) is taken from inshore bays and estuaries from New England to the Gulf of Mexico. The adductor muscle is about 1/2 inch across.

Sea Scallop: The large deep water scallop (*Placopecten megellanicus*) is taken from the waters off the Northern and Middle Atlantic states, with nearly 60 percent of the catch landed at New Bedford. The adductor muscle may be as large as 2 inches in diamter.

Fishing Methods

Scallops in shallow water are sometimes taken with a device known as a "pusher". This is simply a long handle with a frame and web bag attached to one end. The user wades in shallow water pushing the device ahead of him, and catches the scallops in the bag when they rise from the bottom. But most scallops, especially the deep water variety, are now taken with dredges, several of which are pulled behind power boats. Scallops are usually shucked on board the boat, and the "eye" removed. The remainder may be discarded, or used as bait or fertilizer.

Though scallops are found from Maine to the Gulf of Mexico, the greatest beds know are east of Massachusetts, and the industry is centered in the area from Maine to New York. Scallop fishing is seasonal, since most states enforce a closed season (usually April to October) to protect the scallops from overfishing.

Market Forms

Scallops, especially the smaller variety, are usually "plumped" before they are marketed. They are soaked in water to increase the volume about 40 percent. This process makes scallops difficult to preserve, and since they spoil very easily they cannot be shipped to distant markets. Yet, because nearly all consumers demand the large plump "eyes", the practice will probably be continued indefinitely.

Scallops die soon after capture, and therefore are available only in the form of dressed meat. The meat is marketed fresh in 12 and 14 ounce cartons in the chilled display cases. Frozen scallops, both raw and precooked, are also marketed and are usually breaded.

Consumer Inspection

The meat of the sea scallop should be white; that of the bay scallop should be creamy white, light tan, or pinkish. The meat should be firm and, when bought in packages, should be practically free of liquid. Both fresh scallops and thawed frozen scallops should have a sweetish odor.

I-G: GENERAL INFORMATION PERTAINING TO SHELLFISH

How Much to Buy

The quantity of shellfish to buy varies considerably with the serving and cooking method to be used, and the size of the shellfish. The following table is a general guide for serving 6 or 100 people.

TABLE I-G-1: SHELLFISH SERVING GUIDE

	To serve 6	To serve 100
Crabs:		
Hard:		
Live	6 to 12 lbs. (18 to 36 crabs)	90 to 100 lbs
Cooked meat	1 to 2 lbs.	15 lbs.
Dungeness, cooked	4 to 6 lbs. (3 to 6 crabs)	50 lbs.
Lobsters:		
Live	4 to 6 lbs	75 to 100 lbs.
Cooked meat	3/4 to 1 1/2 lbs.	12 lbs.
Oysters and clams:		
In shell	3 dozen	2 1/2 bushels
Shucked	1 quart	3 1/2 gallons
Scallops	1-2 lbs.	15 lbs.
Shrimp:		
Headless (fresh or frozen) . .	1 1/2 - 3 lbs.	24 to 30 lbs.
Cooked meat	3/4 to 1 1/2 lbs.	12 to 15 lbs.

Handling and Storing

Fresh shellfish should be stored at a temperature near 32°F. A temperature even a few degrees higher can cause considerable loss of quality in only a few hours. Fresh shellfish may be kept in the refrigerator in cracked ice or in the meat compartment. Fresh or cooked shellfish meats are easily spoiled, and care must be taken that they are not exposed to bacterial contamination. Ideally fresh shellfish should be cooked within one day.

Frozen shellfish should be maintained at 0°F or lower. Correctly handled and frozen, lobster and crab meat have a shelf life of about two months, shucked oysters, scallops, and clams three to four months, and shrimp six months. Do not refreeze shellfish once it has thawed. (See Part II-D for information on buying frozen seafoods. See Part III-A for seafood thawing methods.)

Shellfish Tips

a. With the exception of scallops, shellfish prices are usually lower in winter than summer.
b. If you harvest oysters and clams yourself, be sure the water you obtain the shellfish from is certified by the State Health Department. If you eat shellfish from closed areas you may get infectious hepatitis.
c. Crabs are dredged in the middle Atlantic states from December 1 to March 31 each year, but this season is noted for the poorest quality crab meat since sand is usually carried into the final product making it gritty.
d. Usually, oysters obtained in the spring of the year are superior to those obtained in the early fall.
e. The smaller the clam, the higher the price. The larger the shrimp, oyster, or scallop, the higher the price.
f. Oysters, clams, and scallops may be packed in their own liquid in jar, but must be completely covered by the fluid to prevent darkening.
g. Lobsters, crabs, and shrimps can be frozen but tend to become tough with storage.

PART II: FINFISH

II-A: CHARACTERISTICS & SPECIES CHART

Characteristics

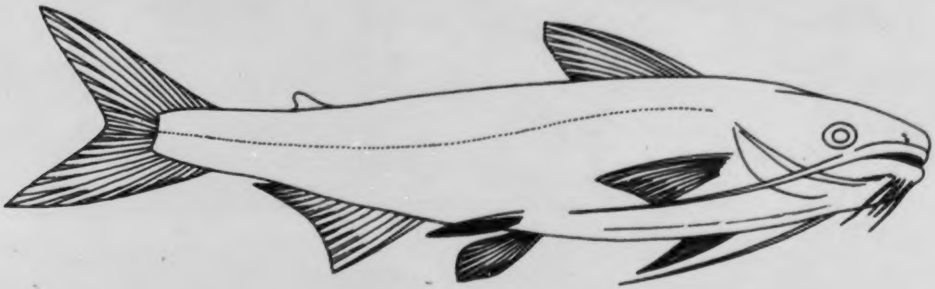
The term "fish" is applied to many aquatic animals which often have very little in common with each other. For general purposes, fish may be defined as cold-blooded animals having a backbone and rudimentary limbs represented by fins. They live in water, breathing by means of gills. Their skin is usually covered with scales or other plates.

Fishing was one of man's earliest pursuits, and the industry has been steadily improved. Fish are caught by many methods, ranging from baited lines to complex nets and dredges.

The following charts give some idea of the variety of edible species of fish and their characteristics.

TABLE II-A-1: FINFISH SPECIES CHART

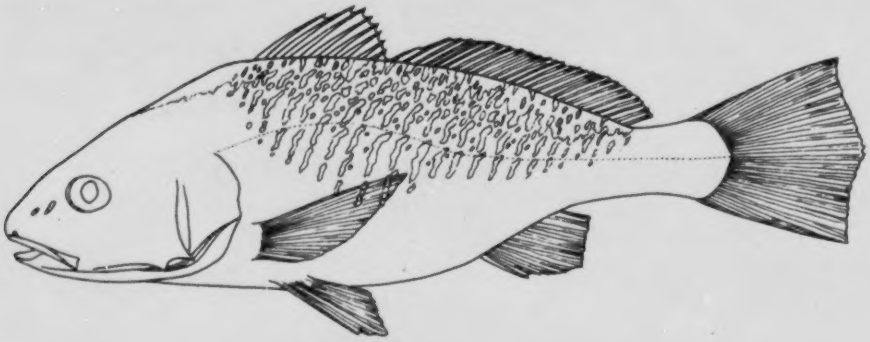
(Courtesy of the Pillsbury Company)



Ocean Catfish

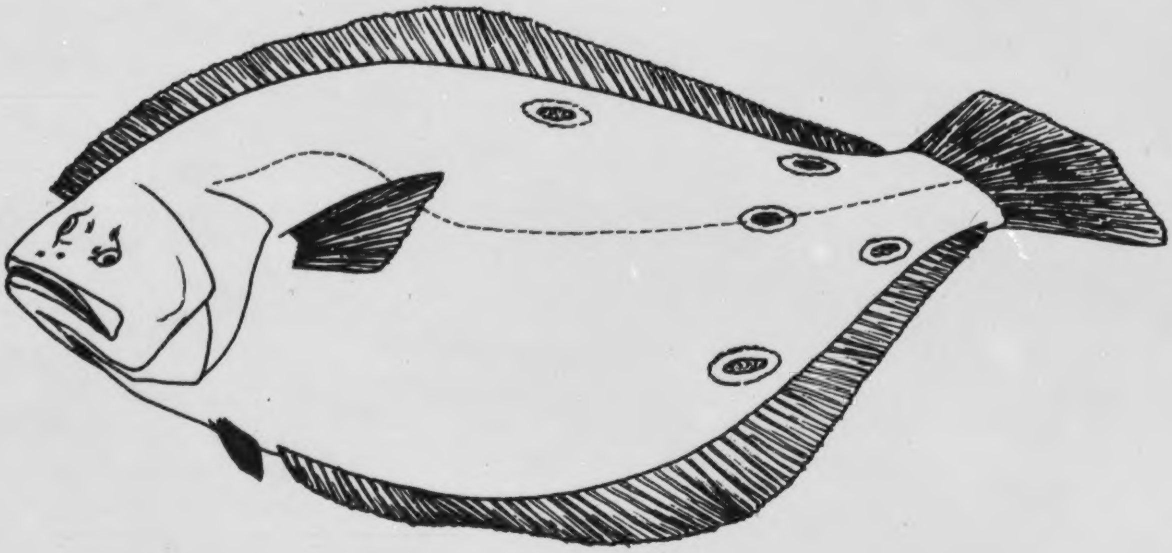
Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Catfish	Bullhead, Blue, Channel.	Great Lakes, other U.S. lakes, inland rivers, ponds, creeks.	Lean	Whole, dressed. Fresh, frozen.	Southern catfish stew. Deep-fried catfish with hush puppies.
Ocean Catfish	Wolf Fish	Iceland, Germany, England, Denmark, Norway.	Lean	Fillets, breaded portions. Frozen.	
Cod	Codfish	New England, Middle Atlantic, Pacific Coast, Iceland, England, Norway, Germany, Denmark, Canada.	Lean	Drawn, dressed, steaks, fillets. Fresh, frozen, salted, smoked (tails). Breaded and precooked sticks and portions.	Baked cod with cream. Sticks or portions served with zesty mustard.

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve



Croaker

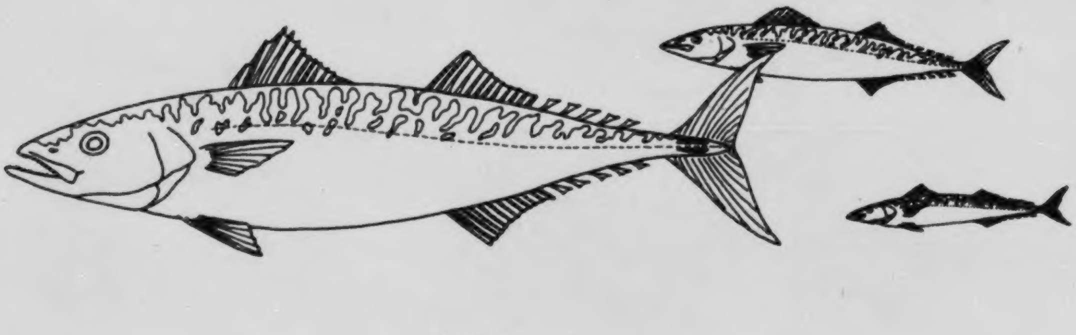
Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Croaker	Hardhead, Drum.	New Jersey, Atlantic Coast to Texas Gulf.	Lean	Round, Pan-dressed, fillets. Fresh, frozen.	Chowder



Flounder

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Flounder	Sole, Fluke, Blackback, Yellowtail Sand-Dabs, Dabs.	Northwest Coast, Gulf Coast, New England, Middle Atlantic, Canada, Denmark, England, Iceland.	Lean	Whole, pan-dressed, steaks, fillets, breaded, stuffed. Fresh, frozen, smoked, pre-cooked.	Grilled steaks. Baked fillets in orange sauce.
Grouper	Red, Black, Yellowfin, Speckled, Hind, Gag, Scamp.	South Atlantic, Gulf.	Lean	Whole, steaks, fillets. Fresh, frozen.	Fillet rollup with Spanish sauce.
Haddock	Scrod (baby)	New England, Canada, Iceland, Norway, England.	Lean	Whole, drawn, fillets. Fresh, frozen, salted, smoked. Breaded and pre-cooked sticks and portions.	Fillets in wine and tarragon sauce. Baked *au gratin*. Hearty fish sticks or portions in sandwiches.
Hake	White, Red, Squirrel, Ling, "Deep-Sea Fillet".	Gulf of St. Lawrence south to North America.	Lean	Dressed, fillets. Fresh, frozen, salted, corned.	Chowder. Baked.

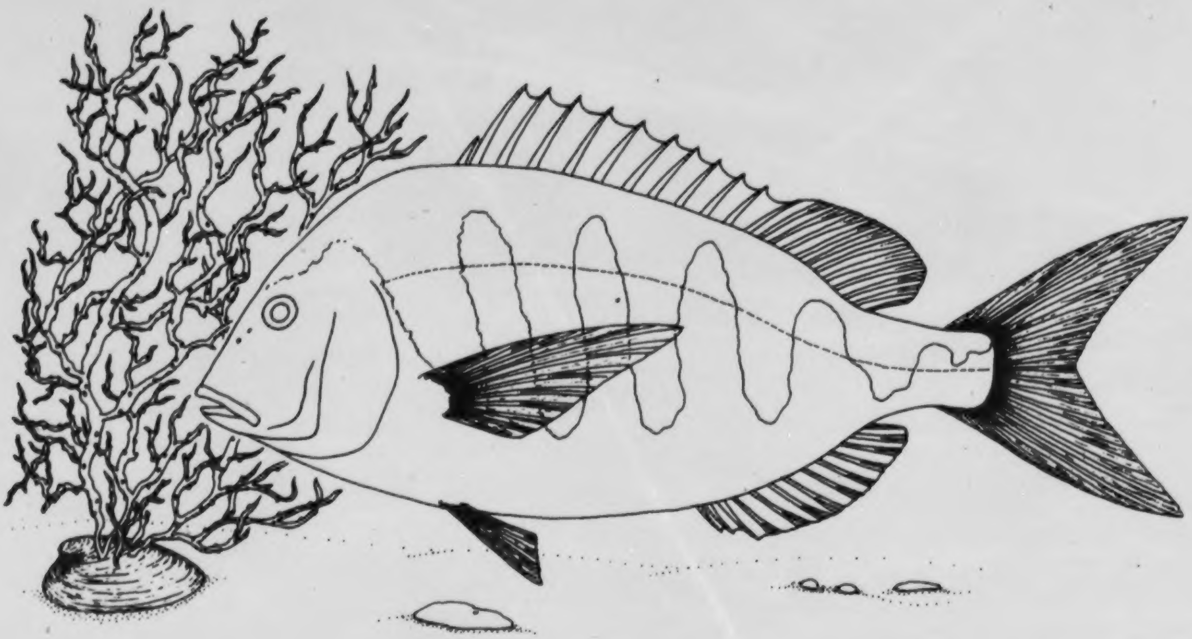
Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Halibut		Pacific Coast, Alaska, New England.	Lean	Drawn, dressed, steaks, fillets. Fresh, frozen, smoked, canned. Breaded portions.	Baked. Stuffed. Broiled. Steaks in herb sauce.
Lake Perch	Yellow Perch	Great Lakes, other U.S. lakes, inland rivers.	Lean	Whole, pan-dressed, fillets. Fresh, frozen.	Deep-fried. Pan-fried.
Lake Trout	Togue	Great Lakes, lakes of British Columbia, Alaska, Northern U.S.	Fat	Whole, drawn, fillets, steaks. Fresh, frozen.	Trout Amandine. Baked whole with herb stuffing.



Mackerel

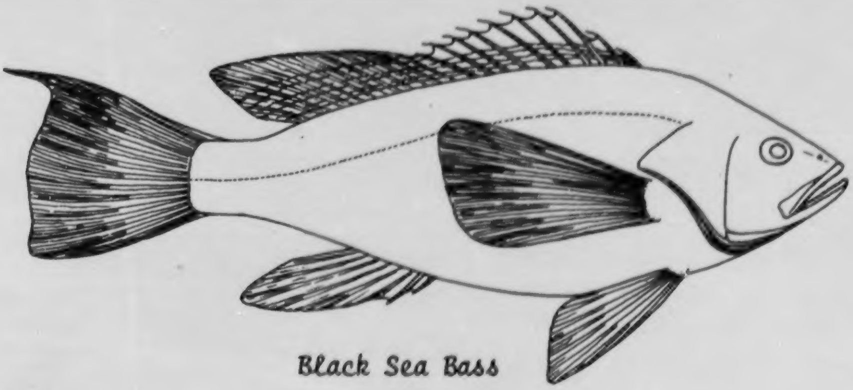
Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Mackeral	Blue, American.	New England, Norway.	Fat	Whole. Fresh, frozen.	Broiled. Baked. Seafood casserole.
Spanish		South Atlantic, Gulf.	Fat	Whole, drawn, fillets. Fresh, frozen.	
King	Cero, Kingfish.	South Atlantic, Gulf.	Fat	Drawn, steaks, fillets. Fresh, frozen.	
Mullet	Striped, White, Jumping, Silver.	Atlantic (Florida to North Carolina), Gulf (Florida to Texas).	Fat	Round, fillets. Fresh, frozen, smoked, salted. Mullet dip.	Baked, with herb-seasoned stuffing.
Ocean Perch	Rosefish, Redfish.	New England, Northwest coast, Iceland, Germany, England, Norway, Canada.	Lean	Fillets. Fresh, frozen. Breaded fillets and portions.	Pan-fried. Baked in white wine sauce. Perch Cumaudine.

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Pollock	Boston Bluefish.	Cape Cod to Cape Breton.	Lean	Drawn, dressed, steaks, fillets. Fresh, frozen, salted, smoked. Raw and pre-cooked breaded sticks and portions.	Baked. Boiled with herb sauce.
Rainbow Trout		Northwestern U.S. (commercial fish farms), Denmark, Japan.	Lean	Dressed, boned, boned and breaded. Fresh, frozen.	Trout Amandine. Charcoal broiled. Baked with lemon butter. Saute Meuniere.
Red Snapper		Gulf, Middle Atlantic, Formosa.	Lean	Drawn, dressed, steaks, fillets. Fresh, frozen.	Poached snapper. Snapper fillet Amandine. Baked. Stuffed.
Salmon Sockeye Chinook Silver Pink Churn.	Red, Spring, King, Silver-sides, Colio.	Pacific Coast, Alaska, North Atlantic, Great Lakes.	Fat	Dressed, steaks, fillets. Fresh, frozen, smoked, canned.	Poached. Baked. Steaks Flourentine. Planked. Charcoal broiled.



Scup

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Scup	Porgy, Paugy.	Southern New England to North Carolina.	Lean	Whole, pan-dressed.	Baked. Broiled with lime and butter.

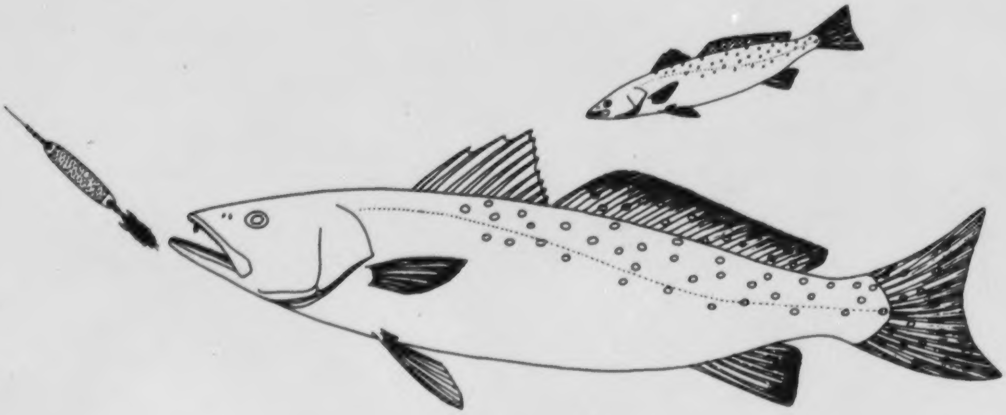


Black Sea Bass

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Sea Bass					
Black & white		Pacific Coast	Lean	Steaks, fillets. Fresh, frozen.	Baked and stuffed. Sauted with tartar sauce.
Common	Blackfish, Black Sea Bass.	New England, Middle and South Atlantic.	Lean	Whole, pan-dressed, fillets. Fresh, frozen.	

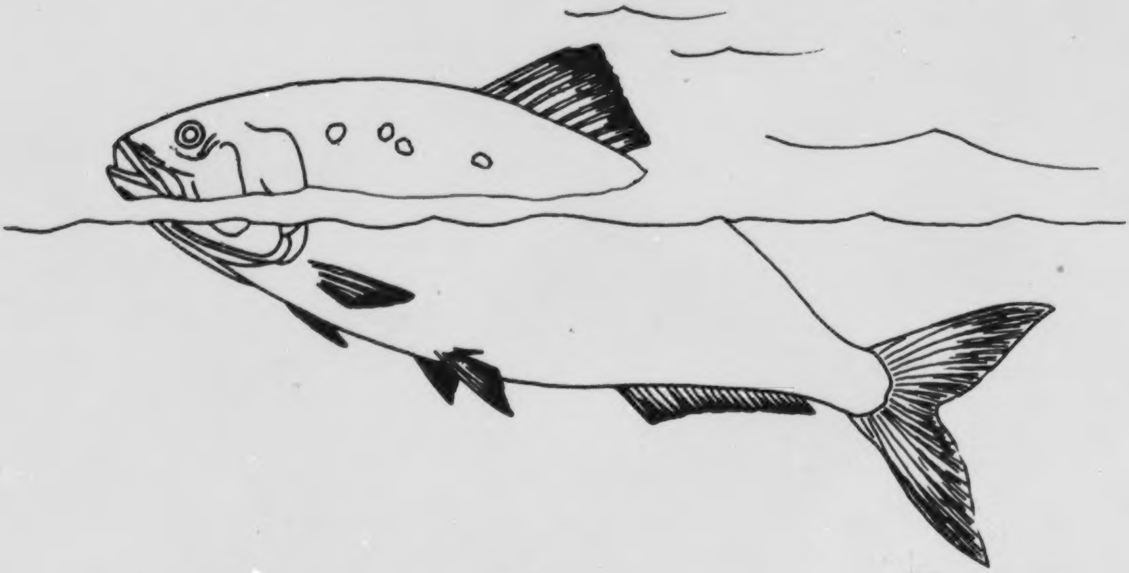
Atlantic Sea Herring

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Sea Herring	Atlantic or Pacific Herring.	New England, Middle Atlantic, Iceland, Denmark, Norway, Germany, England, Scotland, Holland, Sweden, (virtually world-wide).	Fat	Whole, Chunks. Fresh, salted, pickled, smoked. (Sardines).	Herring in sour cream or wine sauce.
Sea Trout					
Gray	Weakfish, Squet-eagues.	Middle and South America,	Lean	Whole, drawn, fillets. Fresh, frozen.	Pan-fried.
Spotted	Speckled Trout.	Middle and South Atlantic Gulf.	Lean	Whole drawn, fillets, Fresh, frozen.	Sauted with lemon butter. Trout Amandine.



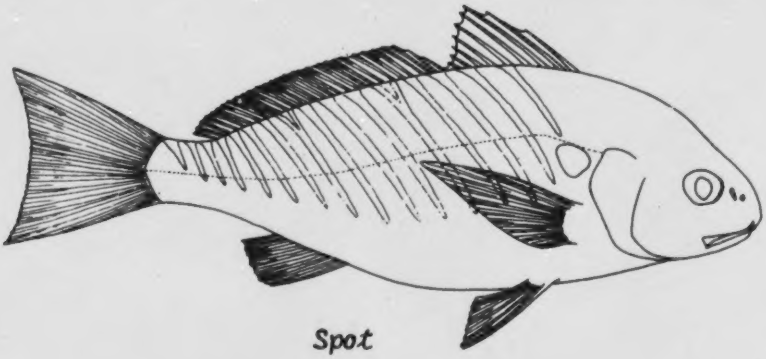
Speckled Sea Trout

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Sea Trout (continued)					
White	Sand Trout	Gulf	Lean	Whole, fillets. Fresh frozen.	
Shad	Buck, Roe, White Shad.	Coastal rivers from Maine to Florida, Washington to California.	Fat	Whole, drawn, fillets, boned. Fresh, frozen, smoked, canned. Shad roe: fresh, frozen, canned.	Boiled with bacon. Baked with toasted sesame topping.



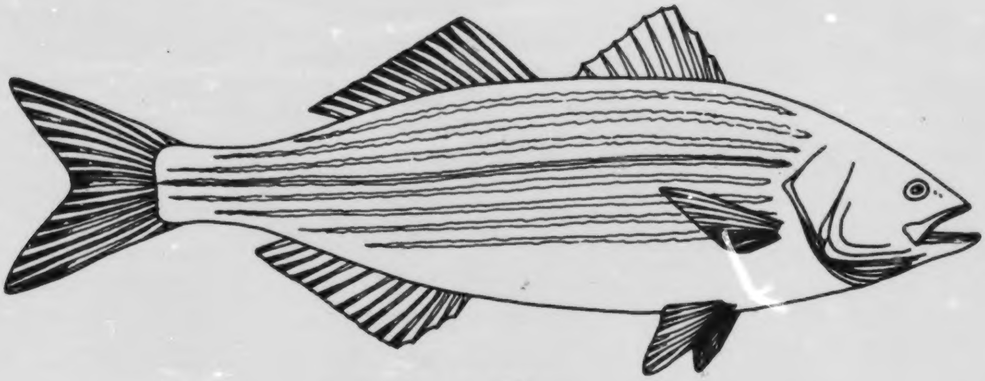
Shad

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Smelts	Whitebait, Surf Smelt, Grunion, Eulachon or Columbia River Smelt, Silverside, Jacksmelt, Bay Smelt.	North Atlantic, Pacific Coast, Columbia River, bays from Mexico to Canada, Great Lakes.	Fat to Lean	Whole, dressed, breaded, pre-cooked. Fresh, frozen.	Pan-fried. Broiled.
Sole	Rox, Petrale, Sand, Grey or Lemon Sole, Dover or English sole,	Pacific Coast, Alaska, Canada, Atlantic Coast, Holland, Belgium, Denmark, England.	Lean	Whole, fillets, breaded, stuffed. Fresh, frozen.	Sole Amandine. Baked fillet with seafood stuffing. Charcoal broiled with lemon butter.
Spot	Goody, Lafayette.	New Jersey to Florida.	Lean	Whole, pan-dressed. Fresh, Frozen.	Pan-fried, Broiled.



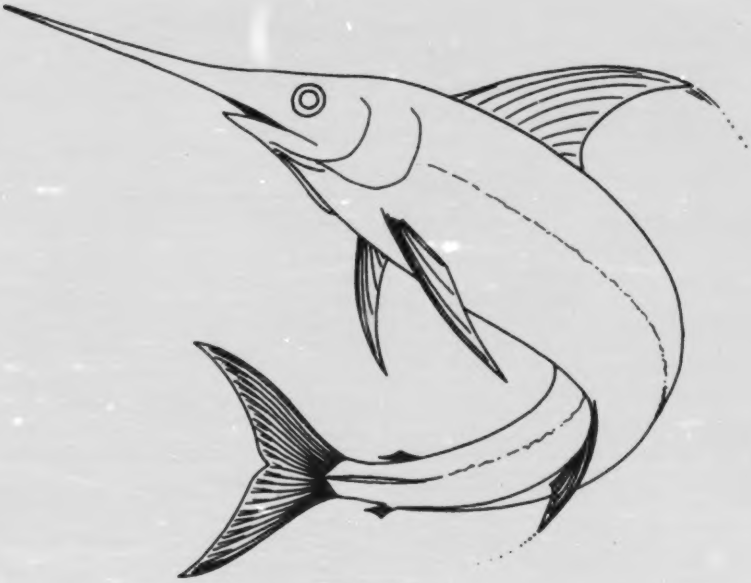
Spot

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve



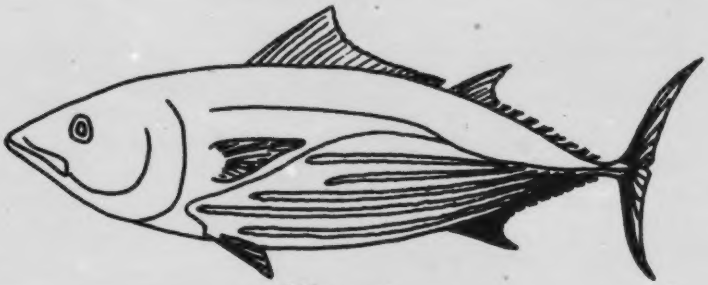
Striped Bass

Striped Bass	Rock, Rock Bass, Rock Fish.	Atlantic Coast, Pacific Coast.	Lean	Whole, drawn, steaks, fillets. Fresh, frozen.	Baked with herb stuffing. Pan-fried with mushrooms.



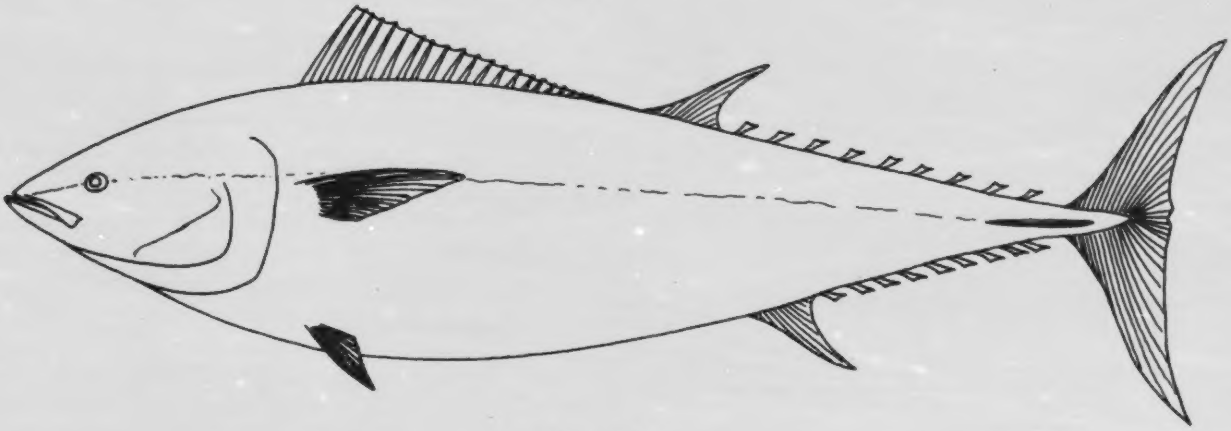
Swordfish

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Swordfish	Broadbill	New England, Middle Atlantic, Pacific coast, Chili, Peru, Japan.	Lean	Dressed, steaks. Fresh, frozen.	Barbecued steak. Grilled. Broiled.



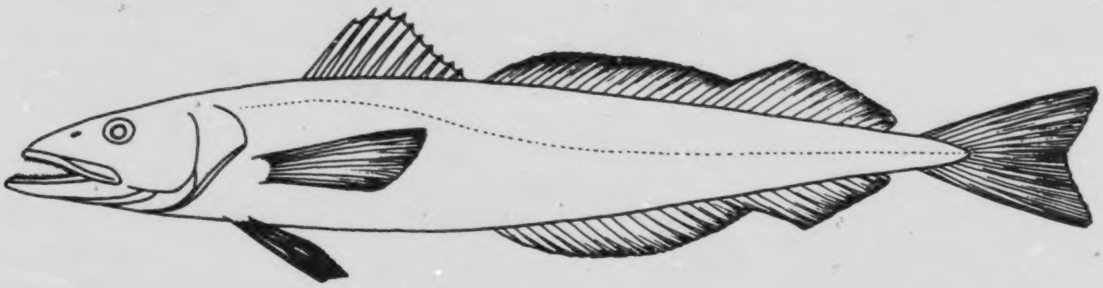
Albacore

Tuna					
Albacore		Pacific Coast	Fat	Canned	
Yellowfin		Pacific Coast	Fat	Canned	Tuna salad.
Skipjack		Southern waters	Fat	Canned	Scalloped casserole.
Blue Fin		Atlantic and Pacific coast	Fat	Canned	
Little		Atlantic and world-wide	Fat	Drawn	Marinated and grilled.



Blue Fin

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Whitefish		Great Lakes, Minnesota, Canada.	Fat	Whole, drawn, dressed, fillets. Fresh, frozen, smoked.	Baked. Broiled. Poached with Hollandaise.

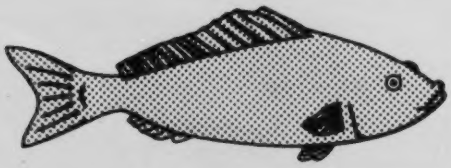


Whiting

Species	Other Names	Where Caught	Fat or Lean	Market Forms	Favorite Ways to Serve
Whiting	Frostfish, Silver Hake.	New England, England.	Lean	Drawn, skinned, breaded. Fresh, frozen.	Deep-fried.

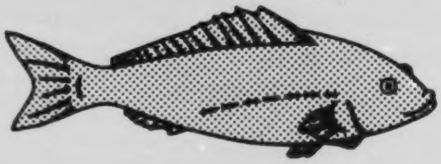
II-B: MARKET FORMS OF FRESH AND FROZEN FISH

Fresh and frozen fish are marketed in various forms or cuts. Knowing these forms and their special uses helps in choosing which kind to buy. The following are known market forms:



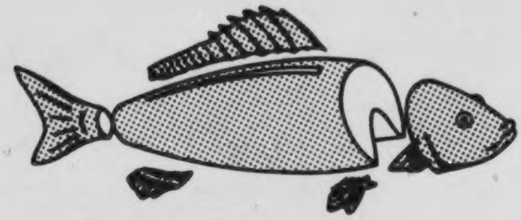
Whole

Fish as they come from the water. Before cooking, the fish must be scaled and eviscerated -- usually the head, tail, and fin are removed. The fish may then be cooked, filleted, or cut into steaks or chunks.



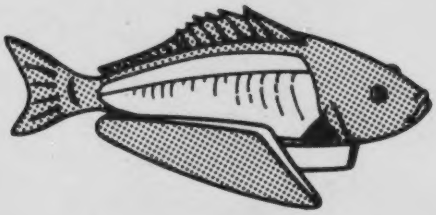
Drawn

Whole fish with insides removed. Generally scaled before cooking, and usually the head, tail, and fins removed. Ask your dealer to do this.



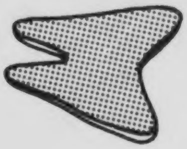
Dressed

Fish with scales and entrails removed; usually the head, tail, and fins are also removed. The fish may then be cooked, filleted, or cut into steaks or chunks. Small dressed fish are called pandressed and are ready to cook as purchased.

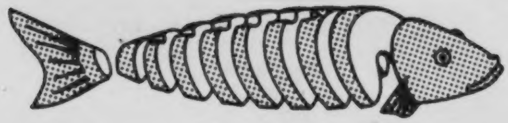


Fillets

Fillets are the sides of the fish cut length-wise away from the backbone. They are ready to cook as purchased. A fillet cut from one side of a fish is called a single fillet. This is the type most generally available on the market. The fillets may or may not include the skin. Only 2 fillets can be cut from one fish.



The two sides of the fish cut length-wise away from the backbone and held together by the uncut flesh and skin of the belly are called butterfly fillets.



Steaks

Steaks are cross section slices from large dressed fish cut 5/8 to 1 inch thick. A cross section of the backbone is the only bone in a steak. They are ready to cook as purchased.

Chunks

Chunks are pieces of the cross sections from large dressed fish. A cross section of the backbone is the only bone in a chunk. They are ready to cook as purchased.

Raw Breaded Fish Portions

Portions are cut from frozen fish blocks, coated with a batter, breaded, packaged, and frozen. Raw breaded fish portions weigh more than 1 1/2 ounces, are at least 3/8 inch thick, and must contain not less than 75 percent fish. They are ready to cook as purchased.

Fried Fish Portions and Sticks

In the 1950's an entirely new line of frozen food products entered the consumer market and were tremendously successful. Today's homemaker has a selection of food in easy-to-prepare forms that were unknown 20 years ago. Frozen convenience seafoods have become popular throughout the nation, with breaded fish portions and sticks leading the field.

As an example of how frozen fish portions and sticks have caught on in the United States, statistics compiled by the Bureau of Commercial Fisheries show that from a beginning in the mid '50s, the combined production of fish portions and sticks in 1968 rose to over 270 million pounds. This figure continues to grow as additional drive-ins, restaurants, schools, institutions, and homemakers are introduced to these convenience seafoods.

Fish portions and sticks are generally made of cod, haddock, or pollock and come in frozen, raw, or partially-cooked forms. Fish portions can be obtained either breaded or unbreaded. They come in a variety of sizes and shapes, carefully defined by FDA standards of identity. The cut pieces are dipped into a batter and coated with breading. Most fish sticks and some portions are then partially cooked. Partially-cooked fish portions and sticks take only minutes to prepare. Uncooked portions and sticks take slightly longer. For best results, follow the directions on the package for cooking time and temperature.

Fish portions range in size from 1 1/2 to more than 5 ounces and come in square, round, and rectangular shapes. Generally speaking, one 8 or 10 ounce package of fish portions will serve two. Raw breaded fish portions are at least 3/8 inch thick and contain not less than 75 percent fish. Partially cooked fish portions are at least 3/8 inch thick and contain not less than 65 percent fish.

Frozen fried fish sticks are 3 to 4 inches long and weigh up to 1 1/2 ounces. They are at least 3/8 inch thick and contain at least 60 percent fish. An 8-ounce package will usually serve two persons.

II-C: CONSUMER INSPECTION AND BUYING

Buying Fresh Fish

The following chart is a general guide for buying fresh fish.

TABLE II-C-1: FRESH FISH BUYING GUIDE

		Fresh	Reject
General Appearance: (lustre and bleaching)		Bright, with metallic lustre. Very little, if any, bleaching.	Bloom completely gone. Color faded or bleached.
Eyes		Bright, translucent, usually full but in some cases may be slightly sunken and somewhat dull.	Dull and sunken. May be cloudy, pink, white or opaque.
Gills	a. Color	Bright red to slightly pinkish red.	Brownish red to brown or gray. Frequently covered with thick, bacterial mucous.
	b. Odor	Fresh odor characteristic of species to faint sour odor.	Medium to strong sour odor.
Odor	a. Poke End	Fresh to very faint sour odor.	Medium to strong sour odor.
	b. At Neck when deheading.	No odor to very slight odor.	Sour or putrid

	Fresh	Reject
Consistency of Fish	Firm and elastic to the touch. Occasionally may be slightly soft.	Generally soft and flabby, separating from bones.
Belly Cavity	Flesh adheres firmly to rib bones.	Rib bones free or almost free from flesh.
Vent	Normal in shape and color.	Protruding and may be discolored.

Buying Frozen Fish

Frozen fish must be handled properly if it is to reach the consumer in good condition. It will not deteriorate while it is deep frozen, but changes in temperature during transporting or handling may result in deterioration of quality.

A check on the following points will help assure that the product has been correctly handled.

a. Flesh should be solidly frozen when received.
b. The flesh should have a firm, glossy appearance with no evidence of drying-out, i.e. no white spots, papery corners or edges, dark spots, discoloration, or fading of red or pink flesh.
c. If wrapped cut fish shows signs of frost inside the transparent wrap, either the fish has been stored for a long time or the contents have thawed and refrozen.
d. Check carefully to see that the container is intact, with no torn or crushed edges.
e. Avoid packages which have been stacked above the load line or frost line of the store's display freezer.
f. Avoid packages with "drip" or ice on the package, an indication that the contents have thawed and refrozen.

g. Check cello-wrap packages for discoloration.

h. If you purchase products of questionable quality inadvertently, return them to the store at once.

Inspection, Standards, and Grade Marks

Frozen fish portions and sticks lend themselves to the advantages of inspection and grading. However, not all these products on the market are inspected and graded. Inspected products may be labeled "Packed Under Federal Inspection", either as a mark or statement. Fish portions and sticks may also bear "U.S. Grade" marks. See Part II-B for a discussion of the standards connected with these inspections and grades.

Portions and sticks are graded on a number of factors that affect the quality of the products. The standards are set by the National Marine Fisheries Service, taking into account consumer needs and industry capabilities. In the frozen state, the portions and sticks are checked for condition of package, ease of separation, broken or damaged pieces, and uniformity of weight and size. Cooked samples are checked for color, texture coating, defects, blemishes, flavor, and odor.

II-D: SPECIAL VARIETIES: SARDINES, SALMON, CANNED TUNA AND EELS

Sardines, salmon, and tuna are given special attention here because they are among the most widely eaten varieties of fish. Eels are considered separately because they are a much overlooked source of excellent seafood.

SARDINES

Characteristics: Maine sardines are the immature young of the Atlantic herring. They have elongated bodies and are greenish blue with a silvery cast on the sides and belly. The tail of the herring is deeply forked and has a single dorsal fin directly over the small ventral fin. Scales of herring are large and loosely attached. Herring reach about four inches in length by the end of the year.

Definition: What is a sardine? The word sardine is not the name of just one species of fish but rather a collective name that represents a variety of tiny, soft-boned fish. The name sardine probably comes from the fact that similar, tiny fish called French sardines were first found and caught in great abundance around the island of Sardinia in the Mediterranean. Caught and enjoyed by Atlantic coastal Indians long before the first white settlers arrived, these tasty little fish are still being caught in the same coves and inlets used by the Indians of long ago.

Uses of Sardines: Sardines are a valuable source of high protein needed for building and repairing body tissues. They contain iron needed for healthy, red blood. Sardines provide useful amounts of thiamine, niacin, and riboflavin. Maine sardines are packed in various types of oil as well as mustard and tomato sauces. Packed in flat 4-ounce cans, they are ready to eat at the zip of a can opener, a pull tab, or a key.

SALMON

Species of Salmon:

Pink (*Oncorhynchus gorbuscha*) is the smallest, weighing an average of four pounds. It has a good red flesh and a delicate flavor. It may be sold fresh or canned. Fresh pink salmon is abundant during July, August, and September.

Sockeye (*O. nerka*) is the next largest, weighing approximately seven pounds. The flesh is deep red and is usually not available fresh.

Coho (*O. kisutch*) is generally classified as the next largest, weighing approximately nine pounds. The flesh is medium red. May be purchased fresh, frozen and canned. Fresh Coho is abundant from July to November.

King (*O. tshawytscha*) is the largest of all the salmon. It is accepted as the best eating of the salmon and usually commands the highest prices. It is obtainable fresh in the early spring or summer, and the year round in smoked or frozen form.

CANNED TUNA

Tuna purchased from supermarkets consists of processed flesh of fish of the following species: Bluefin tuna, Albacore, Blackfin tuna, Big-eyed tuna, Yellowfin tuna, Skipjack, Oriental tuna, and Little tuna. Canned tuna is prepared in the following forms:

a. *Solid* or *solid packs* consists of loins to which no free pieces are added. A piece may be added if necessary to fill a can.

b. *Chunk, chunks, chunk style* consists of a mixture of pieces of tuna in which the original muscle structure is retained. The pieces may vary in size but not less than 50 percent (by weight) shall be retained on a 1/2 inch-mesh screen.

c. *Flake* or *flakes* consist of a mixture of pieces of tuna in which more than 50 percent of the weight of the pressed contents of the container will pass through a 1/2 inch-mesh screen, but in which the muscular structure of the flesh is retained.

d. *Grated* consists of a mixture of particles of tuna that have been reduced to uniform size, that will pass through a 1/2 inch-mesh screen, and in which the particles are discrete and do not comprise a paste.

Any of the above forms of canned tuna may be smoked.

All canned tuna falls within one of the following color designations:

- a. White - limited to the Albacore.
- b. Light - includes any tuna not darker than Munsell value 5.3.
- c. Dark - includes all tuna darker than Munsell value 5.3.
- d. Blended - applied only to a mixture of tuna flakes of which not less than 20 percent by weight meet the color standard for either white tuna or light tuna and the remainder fall within the color standard for dark tuna.

Canned tuna is packed in one of the following optional media.

- a. any edible vegetable oil
- b. olive oil (When solid pack tuna is packed in olive oil, the designation "Tonno" may also appear.)
- c. water

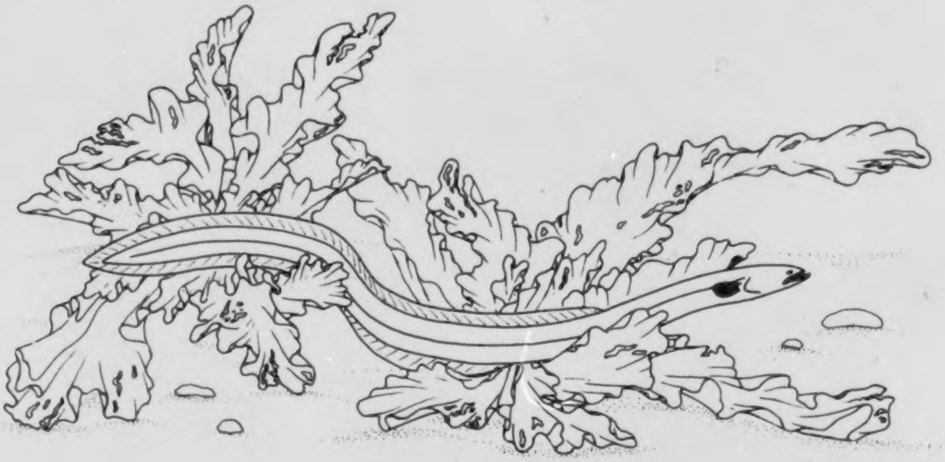
Canned tuna may be seasoned or flavored with one or more of the following:

- a. salt
- b. purified monosodium glutamate
- c. hydrolyzed protein
- d. spices, spice oils or spice extracts
- e. vegetable broth (not to exceed 5 percent of the volume capacity of the container). The broth can be made from beans, cabbage, carrots, celery, garlic, onions, parsley, peas, potatoes, green bell peppers, red bell peppers, spinach, and tomatoes
- f. garlic

EELS

Eels are snake-like fish found in esturine waters as well as the fresh waters of major rivers and tributaries. The American eel (*Anguilla rostrata*) averages 7 to 8 pounds and 36 inches in length, and is found in abundance from Greenland to the Gulf of Mexico. Eels are caught in V-shaped weirs in streams.

Eels traditionally have not been a part of the seafood diets of Americans. However, Europeans have long considered them a delicacy. They are sold fresh, smoked, pickled, and canned.



American Eel

Preparation: Live eels must be killed, cleaned and cooked. One method used in killing eels and also removing the slime layer is to sprinkle them with salt and add just enough water to cover them. Let them soak in this solution for two to three hours before removing and then wash them thoroughly with clean water. Soak them again, however, this time for a half hour only and in fresh cold water. Following this soaking, scrub them with a steel brush to remove the last traces of salt and slime. Following this procedure the eels should be skinned and gutted. The best method of skinning the eel is to drive a nail through the eel's head into a wooden post or board. Using a sharp knife, cut through the skin three inches behind the head all the way around. Care should be exercised to avoid the gall bladder which is located behind the head. Fold the skin back and peel it off with pliers.

The next step is the gutting process. Using a knife, insert it into the vent and cut along the belly line toward the head, stopping at the gills. Cut toward the tail two inches past the vent. Remove the kidneys and if possible pull out the large vein along the backbone. Wash the gut cavity, making sure to remove all traces of blood.

Freezing: Eels can be frozen, however, they do not keep well in home freezers due to their high fat content. If you do attempt to freeze eels, package them well. This will protect other foods in the freezer against off odors and flavors which could develop in eels stored inadequately or stored for too long a period.

Cooking Eels

Fried

Cut in three inch length. Roll in crumbs, dip in slightly beaten egg diluted with two tablespoons of water, roll again in crumbs. Fry in deep fat at 375°F for three to five minutes.

Baked

2 pounds of eel in two inch lengths
1/4 cup olive oil
1 clove garlic, coarsely chopped
a pinch of thyme leaves
juice of 1/2 lemon

Sprinkle blended salt and pepper over pieces of eel. Heat the olive oil in a baking dish. Add garlic and thyme. Place the eel in this hot mixture, squeeze a little lemon juice over it, and bake in a moderate oven (375°) for 25 to 30 minutes.

II-E: HOW MUCH TO BUY

The amount of fish to buy per serving varies with the recipe to be used, the size of the serving, and the amount of bone in the fish. Count about 3 ounces of cooked, boneless fish as a serving, a little less for small children and a little more for adolescent boys and men. The following table can help you decide how much fish, purchased fresh, frozen, or canned, to buy:

TABLE II-E-1: FINFISH SERVING GUIDE

Form	Amt. per person	Amt. for 100
Whole	3/4 pound	90 lb.
Dressed or pan-dressed	1/2 pound	45 lb.
Fillets or steaks	1/3 pound	30 lb.
Portions	1/3 pound	30 lb.
Sticks	1/4 pound	25 lb.
Canned	1/6 pound	15 lb.

II-F: NOW THAT YOU'VE CAUGHT THAT FISH... WHAT ARE YOU GOING TO DO WITH IT?

by Ranzell Nickelson II and Don W. Steinbach

Preparations

Preparations for any fishing trip, short or long, should include a few necessary items that will help the fisherman keep the fish he catches as fresh tasting as the day they were caught - whether they are eaten a day, a week, a month, or six months later. At a minimum, these items include a knife, an ice chest, and plenty of crushed ice. In addition, scaling or skinning tools and even packaging materials may come in handy. Having this equipment on hand, knowing the parts of the fish (Figure 1) and following the simple procedures described here, a fish can be easily and quickly prepared for cooking or freezing.

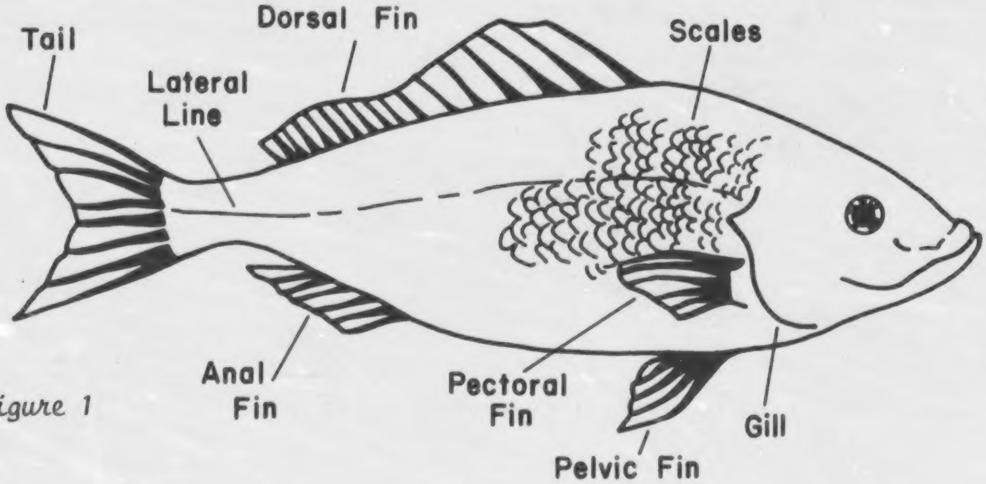


Figure 1

Remember that the way a fish is handled, from the time it is pulled from the water until it appears on the dinner table, is important in preserving good taste and high quality. Ideally, a fish should be removed from the hook or net and gilled, gutted, and iced as soon as possible.

Do's and Don'ts of Fish Handling

Here are some do's and don'ts of fish handling that can affect its taste and storage life. By keeping these suggestions in mind, the fisherman can keep the fresh-caught quality that makes the eating as good as the fishing.

Do's:

. . Do gut, gill, and ice a fish as soon as possible.

. . Do wash the gutted fish in lake water, creek water, saltwater, or tap water to remove as much slime, mud, and blood as possible before icing.

. . Do wrap fish in damp paper or a damp cloth and store in a shady, well ventilated area if ice is not available. This will keep the flesh moist and cool.

. . Do allow for proper bleeding by either removing the head or cutting the tail and positioning the fish in the ice chest so the blood can drain out. Blood remaining in the tissue can speed up the rancidity that develops in fish in frozen storage.

. . Do ice fish generously before transporting it home. Pack the belly cavity with ice and provide adequate ice between fish and the sides of the ice chest. Make a "false bottom" in the ice chest so your fish will not be floating in bloody, melted ice water when you get home.

Don'ts

. . Don't let a fish flop around in the bottom of a boat or on a pier. This will bruise the flesh and speed up biochemical changes (rigor mortis) that may produce an undesirable taste.

. . Don't keep fish on a crowded stringer and/or in shallow, muddy, warm water.

. . Don't leave the gills and guts in a fish for very long after the fish has died.

Most marinas, fishing piers, state parks, etc., have facilities for cleaning fish, and unless you have adequate space at home, it is probably best to make use of these facilities.

The methods of cleaning a fish are as varied as the individual fisherman. Basically, the cleaning process involves gilling and gutting, scaling or skinning, and filleting - not necessarily in that order. Depending on the final use intended for the fish, only one or two of these procedures might be necessary.

Gilling and Gutting

The gills and guts of a fish should be removed as soon as possible since they contain the highest concentration of bacteria that may cause rapid spoilage. The guts also can cause an off-taste in the flesh because of the enzymes in the fish's intestines. After the fish has died, these enzymes digest the walls of the intestinal tract, creating what is commonly known as "belly burn". This is particularly true in a fish that was feeding when caught.

One good way to gill and gut a fish is:

. . Cut into the area under the chin that joins the bottom of the two gill openings; then cut the belly cavity open back to the anal fin (Figure 2).

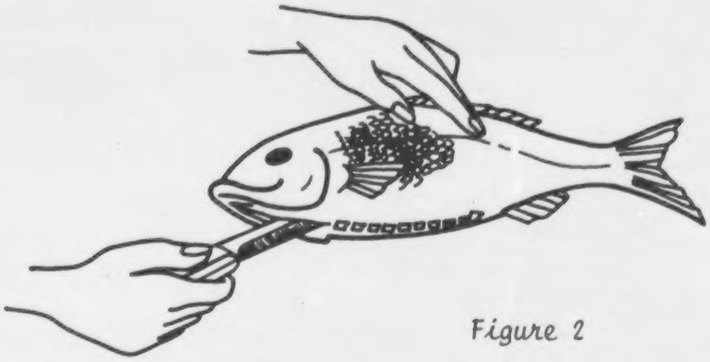


Figure 2

. . Carefully avoid cutting the intestinal tract. If the intestinal contents are spilled onto the flesh of the fish, wash thoroughly.

. . Remove any visible body fat, as it will turn rancid in storage.

. . The kidneys (the dark red mass along the backbone) and inner abdominal lining (either black or a silvery color) should be brushed out under running water (Figures 3, 4).

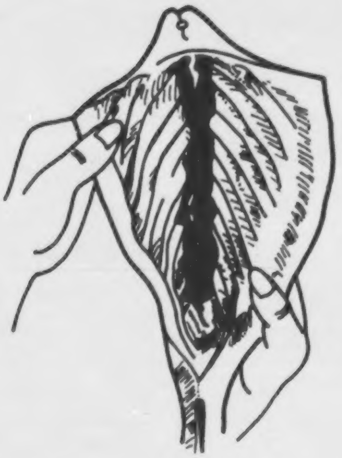


Figure 3

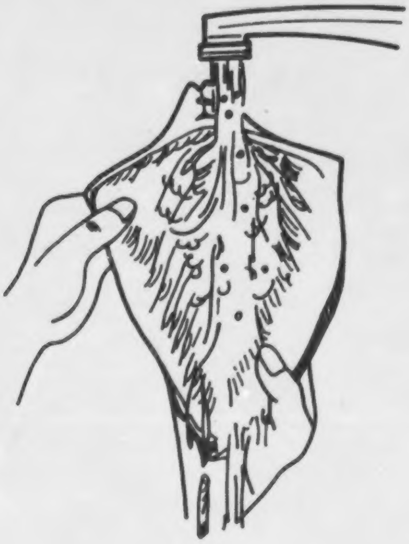


Figure 4

Scaling and Fin Removal

Scaling only (skin left on) is suited for small fish that are hard to skin, or for fish that are to be baked, barbecued or pan dressed.

Scaling is done with a commercial scaler, the back of a knife blade, a tablespoon or the edge of a soft drink can. Use a scraping motion against the grain of the scales, starting at the tail and working toward the head. Fins should be removed by cutting into the flesh (about 3/4 inch) along each side of the fin (Figure 5).

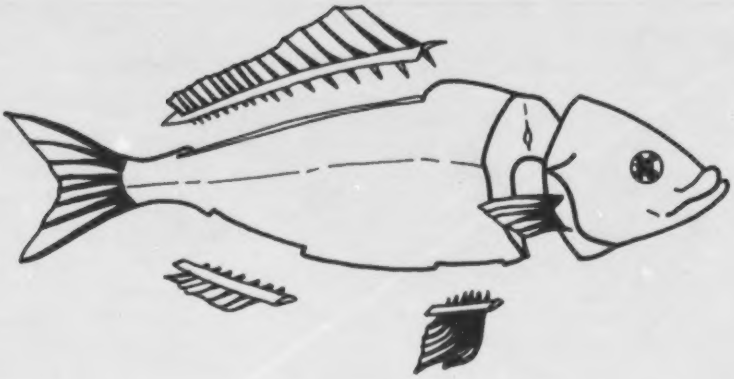


Figure 5

Pull the fin away from the tail and toward the head with either skinning pliers or household pliers. This is also a good time to dehead the fish if it is to be done. A fish prepared this way is "pan dressed". Fins left on a fish can puncture packaging material and cause freezer burn (dehydration).

Skinning

A large portion of the fat found in fish is located directly under the skin. Removing this layer of fat by skinning the fish will reduce the chances of rancidity developing while the fish is frozen. A fish can be skinned without first being scaled, and skinning is almost always part of preparing a fish like catfish, which has no scales.

To skin a scaleless fish, cut the skin only (not the flesh) along the top of the fish and around each of the dorsal and anal fins. Peel the skin away from the flesh with skinning pliers, household pliers, or your fingers--if using your fingers, extra grip can be added by dipping them in table salt.

Catfish can be skinned by cutting the skin around the head or by gripping the skin on top of the bone-like knot directly under the pectoral (side) fin and pulling it toward the tail (Figure 6).

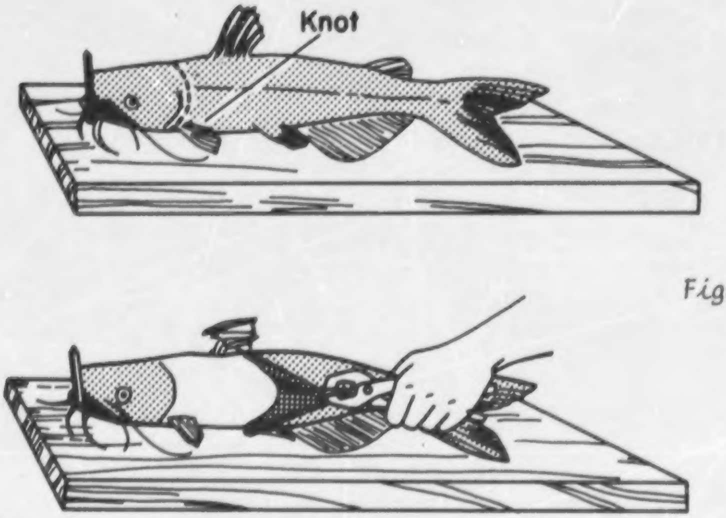


Figure 6

The fish can be held by hand for skinning, but it is usually easier to hang it from a tree limb or to hook its lower jaw on a spike mounted on a skinning board. Skinning pliers are recommended for skinning catfish.

Filleting

Filleting is an easy way to clean a fish and produce a boneless portion of meat - which saves freezing time and space. Fish can be filleted with head, skin, and scales still on and sometimes without removing the guts, although, as mentioned earlier, it is advisable to remove the guts as soon as possible. Filleting can be done with a conventional filleting knife (long, narrow, flexible blade) or a household electric knife.

The filleting process is as follows:

. . Starting at the pectoral fin just behind the head, cut into the flesh at a 45° angle toward the head until you hit the backbone.

. . Turn the knife and follow the backbone all the way to the tail, staying as close to the backbone as possible without cutting it (Figure 7). Some resistance will be noticed as several rib bones must be cut.

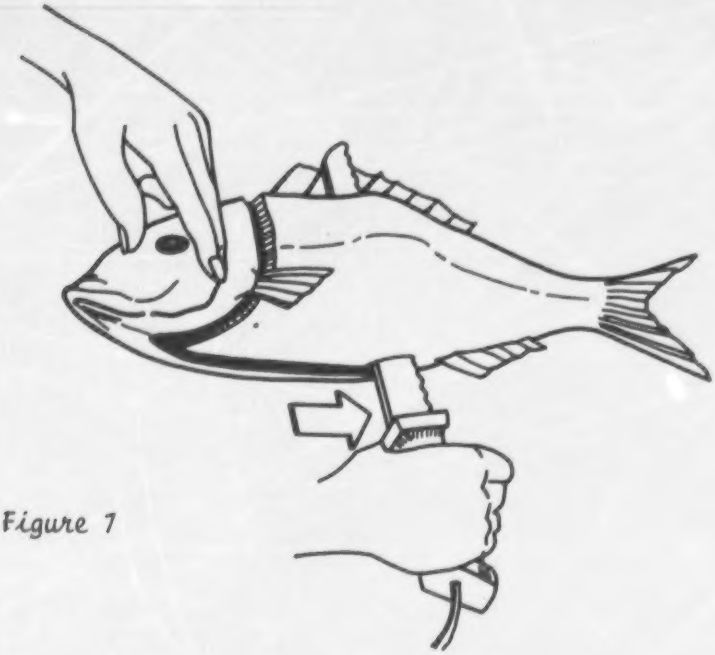


Figure 7

. . Do not cut through the flesh at the tail as this makes it difficult to remove the skin on the fillet.

. . Lay the fillet back from the fish so it is lying on the cutting board with the flesh side up (Figure 8).

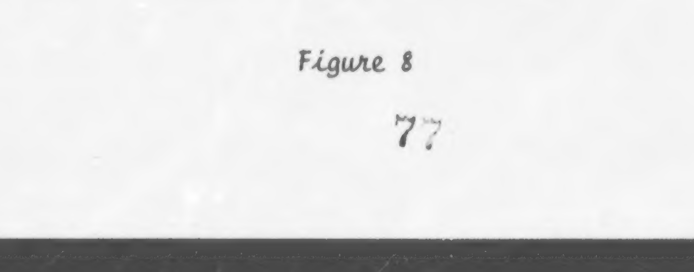


Figure 8

. . Starting at the tail where the skin is still attached, run the knife between the flesh and the skin back toward the head-end of the fillet (Figure 9). By keeping the fillet flat and running the knife close to the skin, little meat is wasted.

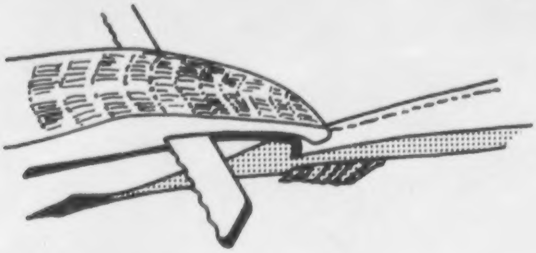


Figure 9

The rib bones may be removed for a completely bone-free fillet. In larger fish, a dark strip of meat can be seen running down the center of the fillet on the skin side. If possible, remove this dark meat.

Always clean the cutting board and utensils with soap and water before and after use. A solution of household bleach (one tablespoon bleach per gallon of water) should be used as disinfectant in addition to soap and water. The bleach solution will help eliminate the unpleasant smells associated with cleaning fish.

Your fish is now ready for cooking or storage. See Part III-A for information on home freezing.

PART III: GENERAL INFORMATION

III-A: HOME FREEZING OF SEAFOODS

Home freezing is not only an excellent method for preserving seafoods, but can be an added economy as well, since fresh seafoods may be purchased in season when prices are generally lower. Because some fresh seafoods are seasonal, it is important to learn the availability of seafoods during certain times of the year. The local fish dealer can provide this information and indicate which varieties are the most economical.

The selection of seafoods to put in a freezer is one of the most important phases of freezing food for the family. Consult Table III-A-1 for important buying characteristics. When purchasing seafoods for home freezing, be sure that they have not been previously frozen. Consult the dealer to be absolutely certain. When transporting seafoods to your home, keep them as cold as possible. A few hours at room temperature or in the trunk of a car on a warm day can completely spoil many seafoods.

Whenever in doubt as to the freshness of seafood, do not freeze it. If you have serious doubts, discard the seafood. Poor handling of fish prior to freezing will make it impossible to obtain good results, since freezing can only protect the quality of the fish as it is when frozen. Freezing cannot improve the quality; frozen foods can be no better than the material you start with.

Preparation of Seafood for the Freezer

When preparing seafoods for the freezer, eliminate all inedible material and debris. For example, scale fish and remove heads and entrails. Dehead and peel shrimp. Eliminating unwanted material will allow additional space in the freezer and lessen the work involved in preparing and serving the dish.

Packaging Materials

The object of packaging is to protect fish from dehydration, oxidation, and contamination. A good package has several characteristics:

A. Moisture proof. Loss of water during frozen storage results in a condition often referred to as freezer burn. The loss of water dries and toughens the food and promotes oxidation. Freezer burn and oxidation are always accompanied by off-flavor, off-odor, and off-color.

B. Low permeability. Permeability refers to the rate at which the packaging material permits vapors and gases to pass between the product and the surrounding atmosphere. There are large differences in the permeability of packaging materials and films.

C. Tightness of fit. A tight-fitting package is essential to prevent moisture loss inside the freezer package. In a loose-fitting package, moisture evaporates from the fish and condenses as ice crystals on the inside surface of the package. If the product is warmed slightly during defrosting or each time the freezer door is opened, the moisture may move from the package surface back to the food surface. When the package cools again, the cycle is repeated. This may continue until a large quantity of water is removed from the food, causing severe dehydration.

D. Other qualities. In addition to the important characteristics listed above, you should look for packaging materials that are strong, easy to apply and relatively inexpensive. See Table III-A-1 following this section for a comparison of packaging materials.

Unfortunately, it is difficult to find packaging material with all the desirable qualities listed. Each material has its advantages and drawbacks. Waxed paper, waxed cartons, cellophane, and polyethylene (the common plastic bag) offer little protection to seafood products. Bread wrappers (a kind of polyethylene bag) are widely used as a home freezer wrap. However, they should never be used because they are such a poor barrier to water vapor and air. Aluminum foil is a wrap to be used with caution. The foil itself is impermeable to gases, but it is difficult to seal properly, thus allowing easy passage of water vapor and air. Additionally, aluminum foil is not a tight-fitting wrap and is easily punctured.

Of the plastic films, polyester, polyvinylidene chloride (saran) and polyvinyl chloride (P.V.C.) are all good barriers to oxygen, and also rank high in most other desirable characteristics of an ideal package. Both saran and P.V.C. will adhere to fresh fish and provide a good fit, if you are careful to crowd out air bubbles. However, saran is not strong at very low temperatures. It is a good idea to overwrap saran packages with a protective paper.

Polyester bags and sleeves are widely used for commercial packaging, but are not practical for home freezing, because air must be evacuated from the bags either by a vacuum pump or heat shrinking. Polyester is most suited for expensive, difficult to hold items such as cooked shrimp, salmon and crab, where the high value of the product offsets the relatively costly package.

Other Preparations for Freezing

In commercial cold storage, most whole fish are glazed with ice, because with proper equipment glazing is the least expensive method of packaging fish. Ice glazing is not easily done in the home, however, and the glaze will not stand up under continued handling. Some home freezer users do a form of glazing by packing fish in suitable containers and filling the containers with water. A good container for this purpose is a tin can such as a 2-lb coffee can. When using such a container, be sure to have at least one-half inch of water over the fish.

Fish and shrimp are often frozen in ice cream and milk cartons filled with water. This practice is acceptable as long as the seafood is completely covered with an ice glaze and the cartons tightly sealed to prevent the transfer of moisture and oxygen out of the package. If the fish touch the sides of the cartons, as often happens, rancidity and "freezer burn" result.

A recommended technique for preserving the quality of seafood is to dip it in a precooked and cooled solution of 5 percent starch. This process will help exclude air from individual pieces when they are frozen. Use about 6 tablespoonsful of corn starch per gallon of water. Be sure to rinse away the starch after the item is thawed and before cooking.

The importance of excluding as much air as possible from the package cannot be overemphasized. Air not only causes oxidation, it also acts as an insulator, slowing the freezing process. While it is advisable to package seafoods under vacuum, most homemakers do not have access to the necessary equipment. The next best thing is to wrap the seafood to exclude as much oxygen as possible. The drug store wrap is suggested. This is done by placing the item on the sheet of wrapping material and bringing the ends together at the top. "Roll the fold" until it is snug against the food. The ends should be folded in a similar manner while pressing out as much air as possible. The wrapping material should then be secured with tape to prevent unfolding.

Another important consideration in packaging is the size of the pieces. Fish to be stored for periods greater than three months should be left whole or in quite large pieces. There is less dehydration per pound when the fish are frozen in this manner.

Trying to guess the age and contents of a frozen package of seafood can be frustrating and wasteful. Many times food is discarded because the storage age is unknown. Although it is unlikely that properly frozen and stored food can become harmful at any age, top quality demands that extended storage be avoided. Label each package with the date, type of seafood, weight, and number of servings or pieces. A crayon or grease pencil is ideal for this purpose. A record attached near the freezer will also be helpful and should carry the same information included on the packages as well as the location of each package in the freezer, the package size, and a current record of the number of packages put into or removed from the freezer. This prevents unnecessary searching for a particular package and the harmful warming of the contents while the freezer door is open.

Using the Freezer

The homemaker can save time, avoid losses, and make freezing seafood a pleasure by planning ahead. The following considerations are important, and should be noted:

A. Check the freezer to see that it is functioning properly. Set it to hold at -4°F. If it won't hold that temperature, it is time to have it repaired or replaced.

B. To maintain the quality of the frozen seafood, adjust the thermostat to the coldest setting about 2 hours prior to anticipated use. Do not guess; check the temperature with a thermometer.

C. Consider the size of the freezer. Generally, about 2-3 pounds of seafood for each cubic foot of freezer space will freeze in 10-12 hours. Try not to overload your freezer by putting in large loads at one time. It takes several days to freeze a hundred pounds of fish and pull it down to storage temperature.

D. It is important that packages be placed in the freezer as soon as they are ready. Usually, the faster the food is frozen, the better the quality and the longer the storage life. Slow freezing may actually allow bacterial and enzymatic spoilage to take place while the food is only partially frozen.

E. To obtain the fastest freeze, place the packages in direct contact with the freezer floor or walls or coils until they are frozen. If the packages takes more than 5 or 6 hours to freeze, they are probably too large.

F. Leave the thermostat at the coldest setting until all the packages have frozen. Then maintain the temperature at 0°F or colder.

G. Avoid temperature fluctuation, which can be harmful to frozen seafood. Arrange the packages in the freezer so that there is adequate space between them to allow good air circulation. Never place unfrozen packages near frozen food. This procedure could cause frozen food to thaw, and the new packages might take 3-4 days to freeze. Generally, the farther away from the freezer door, the more stable the temperature.

Storage Temperatures

One of the most important factors controlling the quality of frozen seafood is the storage temperature. As storage temperature increases, the rate of quality loss also increases. A difference of 8 to 10 degrees can mean a great deal. You can safely assume that it is not possible to store fish at too low a temperature. Cold storage research shows that fish stored at 15°F for as little as two weeks show a significant loss of quality. Most home freezers are designed to hold temperatures between +4° and -4°F. Most of the older cold storage equipment operated at 0° to -4°F. Cold storage facilities for fisheries products are now being designed to hold temperatures from -10° to -20°F.

Storage Time

The length of time fish are held on ice or chilled storage greatly affects the storage time of the frozen product. Experiments have shown that several species of fish held two days on ice have a frozen storage life of twelve months, whereas the same fish held for seven days on ice have a frozen storage life of only two months. The need for rapid handling of fresh fish cannot be overemphasized. Storage life is also dependent on the species of fish. See the section below on the relationship between oil content and storage life.

Although commercial packaging may allow over a year of good shelf life, freezing methods available in the home generally will not permit seafood to be stored that long and still maintain its flavor and texture. Most home-frozen seafood should not be stored over 6 months, and salmon, crab and shrimp not over 3 months. Two to three months or less storage time is ideal for all seafood. A good rule for a continuous supply of high quality frozen food is "first in, first out". Seafood is delicate in flavor and deserves to be eaten at the peak of quality.

Rancidity and Oil Content

The biggest problem in spoilage of frozen fishery products is rancidity. Rancidity appears to be directly related to fat or oil content. Long ago, farm women learned to store their lard in crocks with as small a surface as possible exposed to the air and in a dark, cool place. Heat, light, oxygen and the presence of heavy metal ions, such as copper and iron, enhance the development of rancidity.

Fish oils differ considerably from other animal and plant oils. The oil in fish is long-chain fatty acids, which contain many double bonds. Consequently, fish oil becomes very susceptible to oxidation. It is at the double bonds that atmospheric oxygen combines with the oil molecule to produce a variety of compounds such as ketones, aldehydes, acids, and many others that have not been identified.

Fish may be classified into three categories according to their oil content:

A. Low (less than 5 percent): examples are halibut, cod, flounder, and red snapper.
B. Moderate (5-10 percent): examples are mullet, croaker, and salmon.
C. High (more than 10 percent): examples are herring, mackerel, and lake trout.

Normally, fish of high oil content are more susceptible to oxidation and, therefore, rancidity. Fish possessing a high oil content will become rancid in three months in a freezer unless precautions are taken. Moderately oily fish become rancid in from 9 to 12 months. There are, however, exceptions. King salmon have a fat content of about 15 percent and pink salmon contain 6 percent fat or less. Even though the pink salmon have much less fat than king salmon, they develop a rancid odor and flavor much more quickly than the king salmon do. Some species of fish are extremely difficult to preserve in the frozen form in a home freezer. Herring is a fat fish which is particularly susceptible to rancidity; it should be held at -20°F or lower. Smelt are another group difficult to store for extended periods.

Freezing alone will not prevent rancidity but will slow down the reaction considerably. Treating fish with an antioxidant coupled with vacuum packaging will increase the shelf life. Antioxidants which have displayed excellent results in experiments are butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), ethylenediaminetetraacetic acid (EDTA), 3', 3-thiodipropionic acid (TDP), and propyl gallate. Other good antioxidants which can be purchased at the grocery store are ascorbic acid and citric acid.

For those who glaze fish and wish to use an antioxidant, we recommend ascorbic acid. The fish should be soaked in a 0.1 percent solution for about 1 to 2 minutes, frozen, and then glazed with this solution. A second glazing is advisable. The fish may then be wrapped as previously described.

Other Causes of Spoilage

Besides rancidity, the two major causes of spoilage in frozen foods are protein degradation and brown discoloration. Protein degradation is caused mainly by autolytic and bacterial enzymes which are quite active about 40°F. This spoilage is characterized by ammonia and amine-like odors often experienced in spoiled meats and seafoods. These enzymes are protein in nature, and mobilization or activity decreases as the temperature is reduced. Some enzymes remain active (though activity is low) even at 0°F. A prime example occurs in the freezing of corn on the cob without first blanching; heating inactivates the enzymes. In fishery products there is very little or no enzymatic degradation at 0° to -10°F and these products may remain palatable for many months, all other factors being equal.

Brown discoloration is also known as the browning reaction or the Maillard reaction. This reaction is particularly prevalent when white fleshed fish are cut into steaks or fillets. Extensive research has shown that the reaction is non-enzymatic and is caused by a combining of certain amino acids with reducing sugars. Pentoses (5 carbon sugars) react readily with amino acids which contain sulfur, those amino acids being methionine, cysteine, and cystine. Lysine is also involved. The reaction is characterized by the presence of a brown color much like that of brown wrapping paper. The reaction is inhibited by treatment with antioxidants such as ascorbic acid and TDP.

Proper Use of the Frozen Product

The method of thawing seafood is almost as important as proper freezing. Schedule thawing so that seafood will be cooked soon after it is thawed. Usually the more quickly a product is thawed the better, but never in hot water. Surface spoilage can take place quickly when thawing at room temperature or in warm water if the surface of the package remains at that temperature for several hours.

Place the package of frozen seafood in the refrigerator to thaw. Allow from 18 to 24 hours for thawing a 1-pound package. If quicker thawing is desired, place the packages of frozen seafood under cold running water. Allow 2 hours for thawing a 1-pound package. Thawed fish may be held safely for a day in the refrigerator before cooking. Thawed seafoods should not be refrozen.

Some frozen seafood may be cooked without thawing. Breaded, frozen fish should be cooked this way. In addition, frozen fillets may be cooked without thawing if additional cooking time is allowed. If the fillets are to be breaded or stuffed, however, they should be thawed before cooking.

A warning is in order about thawing smoked or kippered fish. Never leave smoked or kippered fish in a tightly wrapped package after it has thawed. Some smoking methods do not ensure complete destruction of _Clostridium_ _botulinum_ spores. Smoked fish stored unfrozen over a few weeks in an airtight container may be harmful.

Comments

Seafood is tasty, nutritious, easy to prepare, and economical. It commands high priority on a list of preferences for any family meal. Consequently, these delicacies of the sea deserve to be served at their peak of quality. We say to the commercial processor, "Keep the product clean, keep it moving, keep it cold, and keep it stored at a temperature sufficient for proper preservation of the product." This is good advice to the homemaker freezing seafood for her family in the home.

TABLE III-A-1: CHARACTERISTICS OF FREEZER PACKAGING MATERIALS

	Permeability				
Material	Water	Air	Tightness of fit	Strength	Cost
Polyvinylidene Chloride (saran)	Low	Very Low	Very Good	Medium Low	Low
Polyvinyl Chloride P.V.C.	Low	Very Low	Very Good	Medium	Low
Polyester Bags and Sleeves	Very Low	Low	Good	Very High	Low
Ice Glaze	Low	Low	Excellent	Very Low	Low
Polyethylene Wrap and Bags	Medium	High	Poor	High	Low
Aluminum Foil	Low	Low	Fair	Very Low	High
Cellophane	Very High	Medium	Fair	Low	Low
Waxed Paper and Cartons	Very High	High	Poor	Adequate	Low

III-B: U.S. GRADE STANDARDS AND INSPECTION MARKS FOR FISHERY PRODUCTS

Bringing the harvest of the seas to consumers is a complex operation. By nature, fish vary in characteristics and quality. Processing and distribution involve many steps. The wide variety of packaged and prepared fishery products further complicates the task of bringing fish to our tables.

U.S. Grade Standards and Inspection Marks are important aids to orderly and efficient fish marketing. As part of the Voluntary Federal Inspection, grade and inspection marks provide useful standardized information for trade transactions in fishery products.

Grade Standards

Grade standards serve many purposes: they reflect different quality levels of products, they form a basis for sales and purchases, they provide guidelines for in-plant quality control, and they establish a basis for official inspection. Fishermen, wholesalers, processors, distributors--all who are involved in production of fishery products--use grade standards to buy and sell products of known and accepted quality. Consumers rely on gradings as a guide to products of assured quality. In general, then, grade standards identify the relative value, utility, and quality of each unit of fishery products.

The National Marine Fisheries Service assigns U.S. Grade Standards for many high-volume fishery products for mass feeding and direct consumer markets. These standards cover such products as frozen fish fillets and fillet blocks, frozen raw fish portions and fish steaks, frozen raw breaded and precooked fish portions and fish sticks, frozen raw headless shrimp and raw breaded shrimp, and frozen raw and precooked breaded scallops.

"U.S. Grade" Mark

The "U.S. Grade" mark signifies that:

a. The product is clean, safe and wholesome.

b. The product is of a specified quality, identified by the appropriate U.S. Grade designation, as determined by a Federal inspector in accordance with established requirements in U.S. Grade standards.

c. The product was produced in an acceptable establishment, with proper equipment and in an appropriate processing environment as required by food control authorities.

d. The product was processed under supervision by Federal food inspectors and packed by sanitary food handlers in accordance with specific Good Manufacturing Practice requirements.

e. The product is truthfully and accurately labeled as to common or usual name, optional ingredients and quantity.

What Different Grade Standards Mean

Grade A means top or best quality. Grade A products are uniform in size, practically free of blemishes and defects, in excellent condition and possess good flavor for the species.

Grade B means good quality. Grade B products may not be as uniform in size or as free from blemishes or defects as Grade A products. Grade B may be termed a general commercial grade, quite suitable for most purposes.

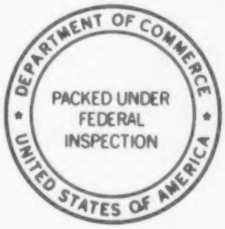
Grade C means fairly good quality. Grade C products are just as wholesome and are generally as nutritious as higher grades. Grade C products have a definite value as a thrifty buy for use where appearance is not an important factor. Consumers today will not find products labeled Grade B or Grade C in the marketplace because products of Grade B and Grade C quality usually are marketed without any grade designation.

Federal Inspection Marks

Federal inspection marks are official marks approved by the Secretary of Commerce and authorized for use on brand labels of fishery products. When displayed on product labels, these marks signify that Federal inspectors of the Department of Commerce have inspected, graded and certified the products as meeting all the requirements of the inspection regulations. The marks further signify that the products have been produced in accordance with official U.S. grade standards or approved specifications.

Inspection Reinforces Grading

Product grading is more valid when done by a neutral unbiased party. The National Marine Fisheries Service provides voluntary Federal inspection on a free-for-service basis, paid for by the plant under inspection. Officially graded and certified products of such plants are eligible to carry the inspection mark and/or the prefix "U.S." on their grade marks, "U.S. Grade A" for example. Products which bear only the inspection mark must be at least Grade B, and most are Grade A. Knowledgeable consumers consider inspection to be an added service by concerned processors on behalf of consumers.



"Packed Under Federal Inspection" Mark

"Packed Under Federal Inspection" may be displayed as an official mark or as an official statement on the product label. The mark or statement signifies that the properly labeled product is clean, safe and wholesome and has been produced in an acceptable establishment with appropriate equipment under the supervision of Federal inspectors. The product has not been graded as to a specific quality level, rather, it is an acceptable commercial quality as determined by Federal inspectors in accordance with approved standards or specifications.

Seafood Products Bearing Grade and Inspection Marks

The distinctive inspection marks are symbols which signify two distinct but related functions in guiding the consumer to safe, wholesome products produced in a sanitary environment, and packed in accordance with uniform quality standards under the supervision of the U.S. Department of Commerce' voluntary inspection service. Many brand-name fishery products carry either one or both inspection marks on their labels. The following list exemplifies the range of fish and shellfish products currently inspected:

a. Frozen Raw Fish Fillets, Portions, and Sticks
b. Frozen Fried Fish Fillets, Portions, and Sticks
c. Fresh or Frozen Whole or Dressed Fish
d. Frozen Raw Breaded Shrimp
e. Frozen Whole Cooked Crabs and Crabmeat
f. Fried Fish Seafood Cakes
g. Raw and Fried Fish Dinners
h. Fried Clams and Clam Cake Dinners
i. Fried Scallops and Fried Scallop Dinners
j. Raw and Raw Breaded Scallops
k. Frozen Fish Steaks
l. Raw Peeled and Deveined Shrimp
m. Cooked Crabmeat, Legs, and Claws
n. Fish and Shellfish in Sauce Dinners

PART IV: SEAFOOD PREPARATION

IV-A: HOW TO SMOKE FISH

by Cherrie Kassem

Curing by exposure to smoke is one means of temporarily preserving fish, and of producing an appetizing flavor.

The best fish to smoke are those with high fat content, such as carp, catfish, salmon, smelt, herring, whitefish, eel and trout. And there are only four steps in preparing your catch: cleaning, brining, drying, and smoking.

The first step is cleaning the fish. Depending on the species, fish may be gutted and beheaded, halved, filleted, or skinned and cut into pieces. Small fish may be smoked in the round (without cleaning). Fresh fish may also be cleaned and frozen for later smoking.

After cleaning, you are ready for step two, brining the fish. Brining means steeping the fish in a solution of salt, water and spices. This process is essential before smoking; it firms the fish by removing moisture. Here are two brine recipes for hot smoked fish:

I

1 gal. water
1 lb. salt
1/2 lb. sugar
1/3 cup lemon juice
1/2 tbs. onion powder
1/4 tbs. garlic powder
1/2 tbs. seafood seasoning
(This is enough brine for 20 lbs. of fish.)

II

6 gal. water
4 lb. salt
1 1/2 lbs. sugar
1 1/2 oz. saltpeter
3 oz. whole cloves (optional)
1 oz. bay leaves (optional)

Directions: Mix ingredients well. Submerge fish in brine and refrigerate 12 hours. Remove fish from brine and freshen under running water for 10 minutes.

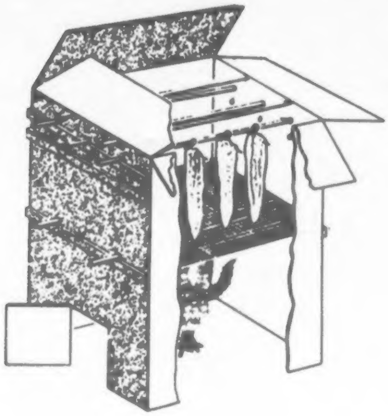
Now you are ready for step three, drying the fish. Pat the fish dry with a cloth, then place them in the refrigerator to drain for one to three hours. Drying increases keeping quality and promotes development of the "pellicile", a glossy finish of dissolved proteins on the fish which gives them the desired appearance.

The last step is the actual smoking of the fish. There are both hot and cool smoking techniques.

Cool-smoked fish require a heavier brine and a smokehouse temperature not over 90°F, in which fish are cooked one to five days. Cool smoking is seldom done, except to preserve fish for long periods.

Hot-smoked (kippered) fish require a smoker temperature of 150 to 200°F, but a shorter cooking time of four to five hours. Hot-smoked fish are perishable and should be refrigerated.

For either process you will need a smokehouse. Your smokehouse may be designed from a large cardboard box, a metal drum, a wooden barrel, or an old refrigerator. The cardboard box is perhaps easiest to obtain; it should be 30 inches square and 48 inches high. Refer to the following diagram and building instructions.



Directions:

a. Remove one end of box to form bottom of smokehouse.

b. Unfasten flaps at opposite end so they fold back and serve as a cover.

c. Strengthen box, if necessary by tacking 3/4 inch strips of wood on outside of box--vertically at corners and horizontally across sides.

d. Cut a door 10 inches wide and 12 inches high in bottom center of one side. Make one vertical and one horizontal cut, so uncut side serves as hinge.

e. Suspend several rods or sticks (iron or wood) across top of box. Cut holes through box, so rods rest on wooden strips. A rack of coarse wire mesh (heavy 1/2" or 1/4" galvanized screen) may replace rods.

f. Arrange fish on rods or rack so they do not touch. Fish may be hung on "S" shaped hooks, strung through gills by rods, split and nailed to rods, or simply laid on rack. Refer to the diagrams which follow for illustrated methods. Use regular nails, 8 or 10 guage steel wires, coat hanger wires, S-shaped iron hooks, and/or round wooden sticks.

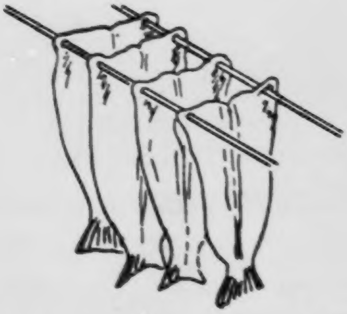


Figure 1. Split fish hung on two ¼" rods

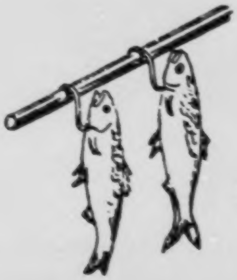


Figure 2. Small whole fish hung on "S"-shaped hooks

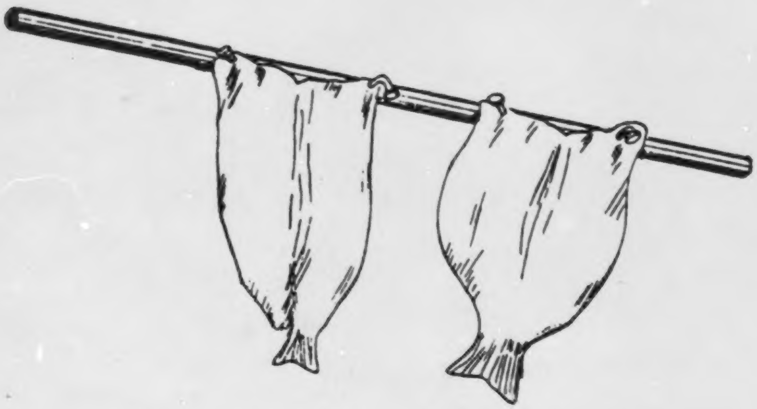


Figure 3. Split fish nailed to wooden strips or large sticks

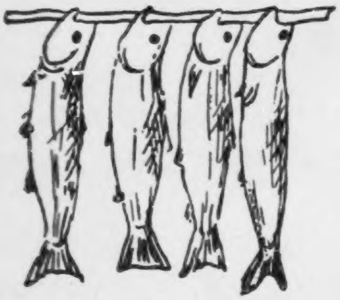


Figure 4. Whole fish strung on round wooden dowels

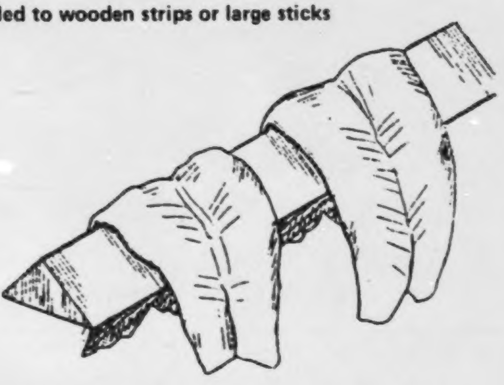


Figure 5. Fillets hung over wooden dowels, or whole fish flat on wire mesh screen

g. Build fire on level ground with nonresinous (hickory, oak, maple, apple) wood chips or sawdust to produce light, constant volume of smoke. Never use wood containing pitch, such as pine. Liquid smoke is also less satisfactory.

h. Center smokehouse over smouldering fire and close flaps. Danger of fire is minimized if ventilation is controlled to promote smoke rather than flames.

i. Monitor fish temperatures by inserting meat thermometer into fleshiest part of fish. Maintain fish temperature of about 180°F for kippered fish. (Temperatures exceeding 200°F cause excessive drying of fish.)

j. Smoke four to five hours.

Fish are ready for serving. Fish not eaten immediately can be stored in the refrigerator or freezer for later use. Smoking fish is fun, economical, and delicious.

IV-B: SPICED AND PICKLED SEAFOODS

by Norman D. Jarvis

Pickling with vinegar and spices is an ancient form of food preservation, going back to prehistoric times. Stevenson (1899) believes that it probably antedates even pickling with salt. It is mentioned frequently in the writings of the Greeks and Romans, as witnessed by the citations of Smidth (1873) and Radcliffe (1921) in their excellent accounts of the fisheries of the ancients. Certain of these fishery products prepared with vinegar and spices were considered great delicacies, selling at such high prices that they were reserved for the banquet tables of the rich. One dish popular in Spain and in the Latin American republics of Central and South America today is "escabeche". It is prepared by frying fish in oil with bay leaves and spices, then marinating in vinegar and oil. This dish can be traced directly to the Romans, who in turn had it from the Greeks.

Pickling with vinegar was used extensively down through the Middle Ages, especially for fish that were fat and did not cure well by the very crude salting methods of the times. While the pickled product did not keep so long, it was more appetizing than the dried and salted products of the period. Vinegar-pickled fish played a very important part in the food economy of the north European people down through the seventeenth century.

Brine-salted fish is often called "pickled", but this is a misnomer, if the name as applied to other food products is considered. Pickled foods are fermented in the process of manufacture with the formation of organic acids. If the amount of organic acids formed is not sufficient, more acid may be added in the form of vinegar; or vinegar may be used in the original cure instead of depending on the natural formation of acid. Therefore, only fish preserved with vinegar or vinegar and spices should be considered pickled.

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Preservation Action of Ingredients

Vinegar differs from salt as a preservative agent in that it does not preserve by osmosis, extracting water from the food, but enters into chemical combination with the product, reducing or inhibiting bacterial activity. The spices used may also have some slight value as a preservative; in fact through the Middle Ages pepper and other spices were valued as preservatives rather than condiments. Foods of this period were often very highly spiced, and it is probable that spoilage was masked rather than inhibited. The preservative action of vinegar is probably due to the fact that spoilage molds are inhibited and bacteria greatly retarded if the product has a low pH, that is, if the medium has an acid reaction. The active principle in vinegar is the acetic acid. According to Tressler (1923) an acid content of 15 percent is required to entirely prohibit bacterial action. Since commercial vinegars average 6 percent acetic acid content, and stronger vinegars reduced to this level are as low as 3 percent when used in food preservation, fish products put up in vinegar are only temporarily preserved. However, vinegars containing 3 percent acetic acid will preserve fish for months if the product is held in chill storage.

Requirements for Ingredients

Fish used in the vinegar-spice cure must, of course, be of the best quality. Equally important, however, in obtaining a finished product of the highest grade, is the quality of the various accessory ingredients. The flavor, texture, color, and to some extent, the keeping quality are affected by the water, salt, sugar, vinegar, spices, herbs, and other miscellaneous ingredients.

The water must be potable and approved under all sanitary and health codes. Pond or shallow-well water should not be used. "Hard" waters are unsuitable, especially those with a high iron, calcium, or magnesium content. If the water supply is hard, the water must be filtered or a softener used. Brines should be boiled and filtered before use.

The vinegar should be clear, without foreign odors or flavors and should have a guaranteed acetic-acid content. Cider or other fruit vinegars should not be used because their acid content is extremely variable and the fruit esters in the vinegar might give the pickled fish an "off flavor". Distilled vinegar is recommended. Acetic acid diluted to the desired strength may be used. A 120 grain (2 1/2 percent) malt vinegar is favored by some commercial packers. Vinegar should be titrated regularly to determine whether it has the required acid content. Wine may be used as a flavoring agent, as in a spiced wine sauce added to the pickled fish, but wine or wine vinegar should not be used in the original pickle cure.

The quality of the salt is also important. A high grade of purity is required. European curers prefer a Liverpool fishery salt. The salt must be as free as possible from calcium and magnesium compounds, as these impurities give a bitter flavor to the cured product. A coarse, half-ground salt will pit the surface of the pickled fish. A finely-ground cooking salt, guaranteed to contain less than one percent impurities and preferably mined, is recommended.

Experienced packers of spiced fish prefer a good grade of cane sugar. Some use is made of corn sugar but the quantity must be adjusted to obtain the same results with the standard formula. It is not a completely satisfactory substitute at present.

Spices should be bought whole and on the basis of chemical and microscopic examination. Buying specifications should require that the spices be fresh and of a high grade of purity. Spices should not be purchased ground as they may be readily adulterated with other plant material. Mixtures of whole spices may be composed of old or inferior spices. As a rule the curer should buy fresh whole spices, singly, and make up his own mixture. Spices should not be held much more than a year.

Essential spice oils should meet the requirements of the United States Pharmacopoeia. Both spices and oils should be bought only from well-known, reputable firms specializing in these products. "Bargain" spices are usually ruinous to quality products.

Herring

Herring is the most important pickled fish product. Some of the more common pickled-herring products are appetitsild, Bismarck herring, cut spiced herring, gabbelbissen, gaffelbiter, Kaiser Friedrich herring, potted herring, rollmops, Russian sardines, gewurz herring, delicatessild, sur-sild, and smorgaas-sild. The names indicate that most of the spiced herring products prepared in the United States are of foreign origin. The composition of the sauce is the principal point of difference between many of these products. Kaiser Friedrich herring, for instance, are Bismarck herring in mustard sauce, while rollmops are Bismarck-herring fillets rolled around a piece of dill pickle. Bismarck herring are boned, with sides still joined, and packed in vinegar and spices.

Spiced herring packed in the United States is prepared entirely from fish cured during the fishing season, held in storage, and made into spiced-herring products as the market requires. Herring may be specially cured for this purpose, although Scotch-cured or Labrador salt herring may be substituted. Herring not specially cured for spicing is reported to have a shorter period of preservation, and to be darker in color, lacking in flavor and tougher and more fibrous in texture.

One of the most common methods for home preparation of salt herring is to pickle it with vinegar and spices. At one time salt herring were used extensively for commercial vinegar-pickled herring but such raw material is used today only when the stock of specially cured herring is exhausted, or in places where they cannot be obtained.

Most of the specially-cured herring are prepared from alewives or river herring (*Pomolobus pseudoharengus*) in the Chesapeake Bay area. A variety of curing methods are used, of which the following is typical: The herring are cut or dressed as described in the salting of alewives. The cut herring are cleaned thoroughly with special attention to removal of the kidney, which is the dark streak along the backbone. The fish are rinsed in fresh water and placed in a curing tank where they are covered with a brine testing 80° to 90° by a salinometer, and containing 120-grain distilled vinegar amounting to an acidity of about 2 1/2 percent. The fish are left in this brine until the salt has struck through, or completely penetrated the flesh. The fish, however, must be removed before the skin starts to wrinkle or lose color. The length of cure depends on the judgment of the curer and varies with the temperature, freshness, and size of the fish. The average length of cure is reported to be 5 days. Various sources give curing times varying from 3 to 7 days.

When the herring are sufficiently cured, they are packed in barrels. These are often second-hand, previously used for soda fountain syrup. As a rule, no attempt is made to pack in regular layers. The herring are simply shoveled in until the barrel will hold no more. The barrels are headed, filled with a salt-vinegar brine testing 70° salinometer, and shipped to marketing centers such as Chicago or New York for final manufacture. There the herring are repacked in kegs which are then filled with a solution of distilled vinegar diluted with water to a 3 percent acidity, and containing sufficient salt to test 35° salinometer. Before the fish are repacked, they may be cut into fillets or the backbone may be removed with the fish left otherwise whole. The kegs are then put into cold storage at 34° F to be held until required.

The final process of manufacture is begun by soaking the herring in a tank of cold water from 8 to 10 hours. They are then removed, drained and placed in a solution of vinegar, salt, and water for 72 hours. The solution is made in the proportion of 1 gallon of 6 percent white distilled vinegar to 1 gallon of water and 1 pound of salt. The fish should be well covered with the solution. They are then made into cut spiced herring, rollmops, or Bismarck herring.

Cut Spiced Herring I

The vinegar-salt-cured herring are cut across the body in pieces 1 to 2 inches long. The sliced herring are then packed in 8-ounce tumblers or in 16- or 32-ounce glass jars, with whole mixed spices. The amount of spices added to each container is approximately one teaspoon to an 8-ounce tumbler, 2 teaspoons to a 16-ounce jar and 1 tablespoon to a 32-ounce jar. A slice or two of onion, a slice of lemon, or a strip of canned pimiento, and a bay leaf or two may be placed around the sides for ornament, depending on the preference of the individual packer. Each container is then filled with vinegar diluted to 2 1/2 percent acidity, containing 1/2 pound of sugar, 1/4 pound of salt, 10 drops oil of cloves, 10 drops oil of allspice, and 10 drops oil of cardamom per gallon of solution. The spice oils are usually added to the sugar before dissolving it in solution to distribute the spice flavor more evenly.

The amount and variety of spice flavors may be altered to suit the taste of the packer or his market. The formula given is typical but is not claimed to be standard. The jars are vacuum sealed, wiped clean, labeled, and packed one or two dozen jars to the fiberboard carton. The length of preservation depends on the care in manufacture and the temperature of the storage. If held under refrigeration at 40°F, this product should remain in good condition at least 6 months. Exposure to light causes the herring to deteriorate more rapidly, even if held under refrigeration, as in a refrigerated show case.

Cut Spiced Herring II

The cut pieces of herring are packed in wooden tubs holding 10 or 20 pounds, or if they are to be repacked in individual glass containers, in kegs holding 100 pounds. A few spices, a bay leaf or two, and several slices of onion are placed in the bottom of the container, then a layer of cut herring, on which are laid spices and onion. This is repeated until the tub or keg is filled. The fish are covered with vinegar diluted with water in which the sugar is dissolved. The containers are then stored at 40°F to cure for 10 days. At the end of this time if the fish are to be repacked, they are removed from storage and packed in 8-, 16-, and 32-ounce glass jars. The vinegar used in curing may be strained and re-used but some prefer to use fresh vinegar diluted to three percent acidity. A few of the spices, bay leaves, and a little chopped onion are placed in each jar.

The quantities given in the formula below are sufficient for 10 pounds of cleaned herring. Whole spices are used in all recipes, unless otherwise specified.

10 lb. salt herring	1/2 oz. cloves
2 oz. mustard seed	2 1/2 oz. sugar
1 oz. bay leaves	4 oz. onions, sliced
1 oz. allspice	2 qt. water
1 oz. black peppers	2 qt. vinegar (6 percent acidity)
1 oz. white peppers	1 oz. red (chili) peppers

There are other recipes for the preparation of cut spiced herring. Cut spiced herring in tubs usually go to delicatessen shops or other wholesale outlets.

Rollmops

The vinegar-cured fillets are wrapped around a piece of dill pickle or a pickled onion. The rolls are fastened with wooden toothpicks, cured several days in a spiced-vinegar sauce, then packed in glass containers, generally of the same sizes used for cut spiced herring. Anderson (1925) made a comprehensive study of the packing of rollmops. The formula given here is the one recommended by him:

10 lb. salt herring
4 oz. chopped onions
2 1/2 oz. sugar
1/4 oz. whole cloves
1/4 oz. chili peppers
1/8 oz. bay leaves
1/8 oz. whole black peppers
1/4 oz. whole allspice
1/16 oz. powdered nutmeg
1/16 oz. cracked cinnamon
1/4 oz. mustard seed
1/16 oz. cracked ginger
1/16 oz. crushed cardamom
2 qt. distilled vinegar (5 percent acidity)
1/8 oz. whole white peppers
8 qt. dill pickles

Put the bay leaves and chili peppers in a small cloth bag so they can be easily separated for later use. Place this bag together with the balance of the spices and 3/4 quart of vinegar into a covered receptacle. Bring to boil and allow to simmer for one and one-half to two hours. Violent boiling causes loss of the volatile acetic acid. A simple way is to put the spices in a common fruit jar and place in boiling water for two hours. Allow to stand 1 to 2 weeks after boiling to insure still greater extraction of the spicing materials. Remove the chili peppers and bay leaves which are to be used for decorative purposes. Strain the pickle through a cloth bag to remove the spices. These should be well mixed, ready for adding to the jars before packing. Slightly less than three-fourths of a quart of pickle will be obtained.

Preparation of the fish: Remove heads, scale and wash. Split into two fillets and trim. Freshen two and one-half hours in running water, then drain. Ten pounds of medium size herring should give about 6 pounds drained weight.

Preliminary vinegar-cure: Pack the fillets skin down in a stone crock. Cover with one and one-fourth quarts of vinegar. If necessary, put a light weight on top to keep the fillets well covered. Allow to cure in a cool place for 40-48 hours. Remove and drain. The vinegar should now test about 2 percent acid and show a salinometer reading of about 30°. The fish has absorbed much of the acid and has lost some salt.

Packing: Cut each dill pickle lengthwise into four parts, then each of these across the center, making eight pieces in all.

Roll the fillets around a piece of pickle and fasten with a fresh clove. A clove serves the purpose just as well as a toothpick and adds to the attractiveness of the pack.

Place one teaspoonful of mixed used spices on the bottom of the jar, then pack the fish. With a medium sized herring, three rolls will pack nicely into a No. 306 jar (six fluid ounces capacity), if placed on end. Decorate around the sides with a couple of chili peppers and a bay leaf. Add sufficient pickle to fill from 25 to 35 cc. (this is about equivalent to two level tablespoonfuls). The net weight should be five and one-half ounces or over. Seal the jars immediately after packing. Vacuum sealing is preferable.

Store in a cool place. Cold storage at about 35°F is advisable to insure longest preservation.

If vinegar-salt cured herring are used, the preparation and preliminary vinegar-cure steps will be unnecessary. It is believed that a better product will be obtained if the vinegar-salt-cure herring are used. Test packs, by the writer, of Anderson's formula indicate that the spice-vinegar sauce should be diluted to 3 percent acidity, that the rollmops should be cured in the spice sauce for 10 days, then repacked in jars with a few spices, and the jars should be filled with fresh 3-percent vinegar with 2 tablespoons sugar and 1 of salt to the quart. Store at 34° to 40°F.

Herring in Sour Cream Sauce

Mild-cure salt (Holland style) herring are filleted, saving the milts. The fillets are soaked in cold water for two hours. The milts are rubbed through a fine sieve. The fillets are drained of surplus moisture. The vinegar, wine, and spices are boiled together for a few minutes, then cooled, and after the spices are removed, stirred into the sour cream, sweet cream, and milts. The fillets are packed in a container with sliced onions, then covered with the sauce. The whole is allowed to marinate in a cool place one week. The fish are then packed in glass jars, which are then filled with the sauce.

1 gal. keg Holland style herring
1 pt. white wine, dry
1 pt. sour cream
1 pt. sweet cream
1/2 pt. distilled vinegar
1/2 oz. mixed spices
2 cups onions, sliced thin

Herring in Wine Sauce

Wine sauce formulas in general are like the standard spice sauce formulas for herring, with the exception that the amount of vinegar is reduced one-half or three-fourths and wine used instead. A dry white, or burgundy-type red wine must be used. Sweet wines are not suitable. A sample wine sauce is given as follows:

1 qt. white wine
1 pt. vinegar, distilled (white)
4 oz. chopped onions
2 1/2 oz. sugar
1/4 oz. mustard seed
1/4 oz. whole cloves
1/4 oz. chili peppers
1/8 oz. whole black peppers
1/8 oz. whole white peppers
1/4 oz. whole allspice
1/16 oz. ground nutmeg
1/16 oz. cracked cinnamon
1/16 oz. cracked ginger
1/16 oz. crushed cardamom
1/8 oz. bay leaves

First the vinegar and wine are poured into a large covered jar, and the onions, sugar, and spices added. The jar is placed in a pan of boiling water for two hours. The jar is allowed to stand overnight. When the sauce is ready to be used, it is strained to remove the spices.

If vinegar-salt-cure herring are being used, the herring fillets are cut in pieces of suitable size, rinsed in fresh water, drained, and packed in glass jars with a few fresh spices, such as bay leaves, chili peppers, and a slice of lemon. The jars are filled with wine sauce, then sealed. The amount of sauce above is enough for about 10 pounds of fish.

If ordinary salt herring are used, they are filleted and freshened in water. The drained fillets are packed in a stoneware crock, covered with 1 quart distilled vinegar 3 percent acidity (for 10 lb. herring) and allowed to stand 48 hours. The fillets are then cut in cubes and packed in jars, which are filled with wine sauce.

Mackerel

Fillets: This formula, developed for mackerel, may be used for other fish. It has been obtained from German sources. Clean and wash the fish thoroughly, then cut into fillets, removing the backbone. Divide the fillets into 2-inch lengths and dredge in fine salt. Pick up with as much salt as will cling to the flesh and pack in a crock or tub. Let the fish stand for one to two hours, then rinse in fresh water. Cook the vinegar, water and other ingredients slowly and gently for 10 minutes after reaching boiling point. Add the fish and cook slowly for 10 minutes longer, counting from the time at which the solution again begins to boil after the fish has been put in. Remove the fish and allow the pieces to drain, then pack them in sterilized jars, adding some chopped onion, a bay leaf, a few spices, and a slice of lemon to each jar. Strain the spice vinegar sauce and bring to a boil. Fill the containers with hot sauce and seal immediately. Store in a cool dry place.

10 lb. mackerel fillets
2 qt. distilled vinegar
3 pt. water
2 cups chopped onion
1 clove garlic, chopped
1 tbs. crushed nutmeg

2 oz. sugar
1 tbs. allspice
1 tbs. cloves
1 tbs. black peppers
1 tbs. bay leaves

Pickled Eels

This dish is a favorite in northern Europe, from the British Isles to Sweden. Clean and skin the eels and cut them into pieces about 3/4 inch thick. Wash and drain the pieces, then dredge in fine salt and allow to stand from 30 minutes to 1 hour. Rinse off the salt, wipe the pieces dry, and rub them with a cut clove of garlic. Brush the eel with melted butter and broil until both sides are a light brown. As an alternative, pieces may be sauted in olive oil or other good salad oil. Place the pieces of cooked eel on absorbent paper. When the pieces are cool, pack them in layers in a crock with a scattering of sliced onion, allspice, bay leaves, mustard seed, whole cloves, peppers, and mace between the layers of fish. Weight the mixture down to keep it compressed. Cover the fish with a cold vinegar sauce made of vinegar, water, onions, and a few bayleaves cooked for 15 to 20 minutes. After standing for 48 hours in a cool place, the eels should be packed in glass tumblers with a thin slice of lemon, a bay leaf, a slice of onion, and a few fresh whole spices for decoration. Fill the tumblers with sauce used in curing, which has been filtered. Seal the containers immediately. Store in a cool, dry place. This article remains in good condition for a considerable period of time.

Oysters

In the eighteenth and nineteenth centuries, pickled oysters were prepared commercially over most of the Atlantic coast area. According to Stevenson (1899) pickled oysters were consumed extensively around New York during the Christmas holidays. They are not nearly so popular now and are usually prepared only for special orders. Some pickled oysters are prepared in Virginia for local consumption. Various formulae are available, some from traditional colonial sources, while others may be found in French or other continental cookbooks. Two typical formulae are given here:

Virginia Pickled Oysters I: Open one gallon of oysters, saving the liquor. Strain the liquor and add sufficient salted water to bring the amount up to 3 pints. Simmer the mixture gently over a low flame. When the liquor is near the boiling point, add the oysters a few at a time, cooking until the "fringe" curls. The oysters are then removed from the liquor and set aside to cool. Make a sauce of vinegar, white wine, bay leaves, onion, garlic, parsley, fennel, thyme, cloves, black pepper, allspice, cinnamon, and mace. Add this sauce to the oyster liquor and simmer 30 to 45 minutes. When it is cool, pack the oysters in glass jars with a bay leaf, slice of lemon, and a few fresh spices in each jar. Strain the liquor and when it is cool pour it into jars, seal immediately and store in a cool dark place. The oysters are ready for use in 10 to 14 days.

1 gal. shucked oysters
3 pt. oyster liquor
1 pt. distilled vinegar
1 pt. white wine, dry
2 tbs. ground onion
2 cloves garlic, crushed
1 tbs. chopped parsley stems
2 tbs. bay leaves, crushed

1 tbs. crushed fennel
1 tbs. crushed allspice
1 tbs. crushed black peppers
1 tbs. crushed cloves
1 tbs. crushed stick cinnamon
1/4 tbs. crushed mace
1/4 tbs. crushed thyme

Pickled Oysters II: Blanch one gallon of freshly opened oysters until the fringe curls. Remove the oysters and set them out to cool. Bring the liquor used in blanching to the boiling point, then set aside to cool. At the same time cook the vinegar and spices together slowly, after which strain out the pieces. Combine the oyster liquor and spiced vinegar. Pack the oysters in glass tumblers with a bay leaf and a thin slice of lemon in each. When the sauce is cool, strain it and pour over oysters until the containers are filled. Seal the tumblers immediately and store in a cool, dark place.

1 gal. shucked oysters
2 qt. oyster liquor
1 qt. vinegar
1/2 oz. cloves, whole

1/2 oz. allspice, whole
1/2 oz. black peppers, whole
1 blade mace

Mussels

This formula may also be used in pickling clams and oysters. Scrub the shells well and steam just enough to open the shells. Save the liquor or nectar. Remove the meats from the shells, cutting out the byssus or beard. Cool meats and nectar separately. When cool, pack the meats in sterilized glass jars with a bay leaf or two, a few whole cloves, and a thin slice of lemon to each jar.

Strain the liquor obtained in steaming the shellfish. To each quart of liquor add one-half pint distilled vinegar, one-half tablespoon each of allspice, cloves, and red peppers, with one-quarter teaspoon of cracked whole mace. Some recipes for pickled mussels call for white wine or wine vinegar instead of distilled vinegar. The amount of wine or vinegar is a matter of personal taste. Simmer for 45 minutes. When the sauce is cool, pour into the jars, and seal. Store in a cool, dark place. This product will be ready for use in about two weeks. Pickled mussels and oysters turn dark if exposed to the light.

Shrimp

Pickled shrimp is a regional speciality of the New Orleans area but is sold in fish markets from Key West to Washington, D.C. There are no standard recipes but those given here are believed to be typical.

Pickled or Spiced Shrimp Formula I: Peel the green shrimp and wash them well. Make a brine of 1 gallon water, 1/2 cup salt, 1 pint distilled vinegar, 1 tablespoon red peppers, 1/2 tablespoon cloves, 1/2 tablespoon allspice, 1/2 tablespoon mustard seed, and 6 bay leaves. Simmer the brine slowly for 1/2 hour, then bring it to the boiling point, and add the shrimp. When they have cooked for 5 minutes, counting from the time the brine again begins to boil, they should be removed and allowed to cool. Pack in sterilized jars with a bay leaf, a few fresh spices, and a slice of lemon in each jar. Fill the jars with a solution made in the proportions of 2 pints of water, 1 pint of 5 percent distilled vinegar, and 1 tablespoon sugar. Seal the jars tightly and store in a cool, dark place. These pickled shrimp keep longer than those prepared by the second method, but the second pickled shrimp product requires less labor and is cheaper.

Pickled or Spiced Shrimp Formula II: Take 5 pounds of fresh, green headless shrimp. Wash them well but do not remove the shells. Put celery tops, salt, parsley, thyme, bay leaves, vinegar, and spices into the water. When this has boiled about 45 minutes, add the shrimp. Let boil 10 minutes, then set the pot aside and allow the shrimp to cool in the liquor. Drain and pack in small cartons with some of the spices. This product remains in good condition only a very short time unless held under refrigeration.

5 lb. shrimp	1 tbs. allspice
1 gal. water	1 tbs. bay leaves
1 pt. vinegar, distilled	1 tbs. red (chili) peppers
2 cups salt	1 tbs. black peppers
1 bunch celery tops	1/2 tbs. cloves
1 small bunch parsley	1 blade mace

Literature Cited

Anderson, Clarence L. 1925. Preserved pickled herring. University of Washington Publication in Fisheries, vol. 1, no. 1, p. 1-64.

Hoffman, Herbert. n.d. Lehrbuch der Fischverwertung fur die Fischindustrie. (Eighth revised edition, Lehrbuch der Fischbereitung. Wilhelm Dunker.) 197 p. Stettin.

Jacobsen, Eduard. 1926. Handbuch fur die Konserven Industrie, Donserven Favriken und den Donserven Grossbetreib. Bd. 2, 1459 p. Paul Parey, Berlin.

Jarvis, Norman D. 1943. Home preservation of fishery products. Salting, smoking, and other methods of curing fish at home. U.S. Department of the Interior, Fish and Wildlife Service, Fishery Leaflet 18, 26 p.

Radcliff, William. 1921. Fishing from the earliest times. 478 p. William Clowes and Sons, Ltd., London.

Smidth, J. K. 1876. Historical observations on the condition of the fisheries among the ancient Greeks and Romans, and on their mode of salting and pickling fish. United States Commission of Fish and Fisheries, Report of the Commissioner for 1873-4 and 1974-5, Part III, App. A, P. 3-20.

Stevenson, Charles H. 1899. The preservation of fishery products for fish. U.S. Commission of Fish and Fisheries, U.S. Fish Commission Bulletin for 1898, p. 335-563.

Tressler, Donald K. 1923. Marine products of commerce. 762 p. Reinhold Publishing Corporation, New York.

IV-C: OUTDOOR COOKERY

Thousands of people agree that food rarely tastes better than when properly cooked out-of-doors. The reason? Probably because the open air, the relaxed, congenial atmosphere, and the tantalizing aroma of outdoor cookery all combine to whet the appetite and sharpen the taste.

Fish and shellfish are no exception to this happy rule, and almost all varieties adapt readily to outdoor cooking and eating. Whether your equipment is a simple charcoal grill, or an elaborate electric or gas grill, or a primitive campfire, the results can be equally successful. Important aspects of outdoor seafood cookery are:

a. care in selecting and preparing the fish and shellfish;
b. cooking the seafood until just flaky when tested with a fork. Overcooking of tender, succulent fish and shellfish is apt to toughen and dry them;
c. controlling the heat; and
d. marinating, basting, or coating the fishery products to keep the juices in.

Operating A Gas Grill

To light the grill, raise the hood or uncover. Remove grid, if manufacturer recommends. Strike long style match or light a soda straw. Turn gas valve to "high" -- follow manufacturer's instructions if grill has pilot light. Hold match at ignition point.

Leave valve on "high" to preheat, but do not lower hood. If burner is below food, preheat for 10 to 15 minutes. If burner is above food, preheat for one minute.

Before placing food on grid or rotisserie, adjust valve to proper setting. Experience and personal preferance will help you find the best setting. With outdoor grills, allow for climate conditions.

Follow manufacturer's directions for cooking on grid and rotisserie and for cleaning grill.

Operating A Charcoal Grill

Line the bottom of the fire bowl with heavy-duty aluminum foil for easier cleaning later. To prevent the grill from burning out, line the bottom of the firebox with a layer of small pebbles or vermiculite. This permits the fire to breathe, giving more heat from the coals. Make charcoal layer slightly wider all around than the food to be cooked on the grill.

Start the fire sufficiently in advance so you will have a good bed of coals when you start barbecuing. One method used, which takes about 45 minutes, is to stack briquets in pyramid, and soak lightly with any recommended charcoal lighting fluid. Let stand 1 minute, then light. Many commercial forms of lighter fluid, easily ignited mats, and other lighting aids are available. WARNING: AT ALL TIMES TAKE NECESSARY PRECAUTIONS WHEN LIGHTING THE FIRE. NEVER USE GASOLINE! When the surface of the charcoal is covered with a gray ash, spread the coals evenly and the fire is ready.

For smoke flavor use wood chips from apple, oak, maple, hickory, and cherry to give smoke flavor to fish. Soak chips in water at least an hour before using, so they will give maximum smoke and not burn too rapidly. On a charcoal grill, add a few chips at a time to the charcoal while cooking. If chips flame up, add more wet chips. For a gas grill, scatter wet chips directly on the ceramic briquets for added flavor, or -- for a more subtle flavor -- wrap them in perforated foil before placing them on the briquets.

Remember, never overcook fish. Cook only until they flake easily when tested.

IV-D: TIPS FOR COOKING & SERVING

How To Cook Fish

Fish are delicious - if cooked properly. We cook fish to develop their flavor, to soften the small amount of connective tissue present, and to make the protein easier to digest. Cooking fish at too high a temperature or for too long a time toughens them, dries them out, and destroys their fine flavor.

How can you tell when fish are cooked? Raw fish have a watery, translucent look. During the cooking process the watery juices become milky colored, giving the flesh an opaque, whitish tint. This color change is unmistakable. When the flesh has taken on this opaque whitish tint to the center of the thickest part, fish are completely cooked. At this point the flesh will easily separate into flakes, and if there are bones present, the flesh will come away from then readily.

Most cooked fish tend to break up easily, so handle fish as little and as gently as possible during and after cooking to preserve their appearance.

Baking: Baking is a form of dry heat cooking and is one of the easiest ways to cook fish. But "bake fish easy" is the most important guide to follow in fish cookery. Fish like a preheated, moderate oven set at 350°F for a relatively short period of time. This keeps the moistness and flavor in the fish, prevents drying, and keeps the fish tender and palatable. Fish not baked in a sauce or with a topping are basted with melted fat or oil to keep the surface moist.

Can fish be baked from the frozen state? Yes, provided the cooking time is increased to allow for thawing during the baking process and provided the recipe does not call for special handling such as stuffing or rolling.

Broiling: Broiling, like baking, is a dry heat method of cookery but in broiling the heat is direct, intense, and comes from only one source. Thin foods tend to dry out under the broiler, so when planning to use this method, choose pan-dressed fish, fillets, or steaks which are about 1 inch thick in preference to the thinner ones. If frozen, the fish should be thawed. Baste fish well with melted fat or oil or a basting sauce before placing them under the broiler. Baste again while broiling to keep the fish moist.

Follow the range manufacturer's directions for the operation of the broiler and preheating. The length of time it takes to broil fish depends on the thickness and the distance they are placed from the heat. As a general guide, have the surface of the fish about 3 to 4 inches from the source of heat and place thicker cuts farther from the heat than thin ones.

Cooking time will usually range from 10 to 15 minutes to reach the "fish flake easily" stage. As a rule, the fish do not need to be turned because the heat of the pan will cook the underside adequately. Turn the thicker pieces, such as pan-dressed fish, when half the allotted cooking time is up. Baste again with fat or sauce. Always serve broiled fish sizzling hot.

Charcoal Broiling: Charcoal broiling is a dry heat method of cooking over hot coals and in recent years has become a popular form of recreation. Fish, because they cook so quickly, are a natural for this method of cookery.

Pan-dressed fish, fillets, and steaks are all suitable for charcoal broiling. If frozen, the fish should be thawed in advance. Because fish flake easily as their cooking nears completion, use of a well-greased, long-handled, hinged wire grill is recommended.

Since charcoal broiling is a dry heat cooking method, thicker cuts of fish are preferable as they tend to dry out less during the process than thin ones. Also, to ensure serving juicy and flavorful fish, use a sauce that contains some fat and baste them generally before and while cooking.

Fish are usually cooked about 4 inches from moderately hot coals for 10 to 20 minutes, depending on the thickness of the fish.

Frying: Frying is a method of cooking food in fat. For frying, choose a fat that may be heated to a high temperature without danger of smoking. This is necessary because a smoking fat begins to decompose and will give the food an unpleasant flavor. Because they begin smoking at higher temperatures, vegetable oils and fats are preferable to fats of animal origin.

The temperature of the fat is extremely important. Too high heat will brown the outside of the fish before the centers are cooked. Too low heat will give a pale, greasy, fat-soaked product. The most satisfactory frying temperature for fish is 350°F.

Frozen fish must be thawed before frying. Separate the pieces and cut to uniform size.

After frying, drain the fish immediately on absorbent paper to remove excess fat. Keep the fish warm in a low oven until all pieces are cooked, then serve immediately.

Deep-fat frying: Deep fat frying is a term applied to cooking in a deep layer of fat. It is a quick method of cooking and is an excellent way to cook tender foods and precooked foods.

For deep-fat frying you need a heavy, deep saucepan or French fryer with straight sides, a fry basket to fit the fryer, a deep-fat frying thermometer, or an electric fryer with automatic temperature control. Use enough fat to float the fish but do not fill the fryer more than half full. You must allow room for the fish and for the bubbling fat.

The fish may be dipped in a liquid and coated with a breading, or dipped in batter. The coating will keep the fish moist during frying and will give them a delicious crispness.

Place only one layer of fish at a time in the fry basket and allow enough room so that the pieces do not touch. This prevents the temperature of the fat from dropping suddenly and assures thorough cooking and even browning. When the fat has heated to the proper temperature, lower the basket into the fryer slowly to prevent excessive bubbling. If the fat is at the right temperature when the fish are added, a crust forms almost immediately, holding in the juices and at the same time preventing the fat from soaking in. Fry until the fish are golden brown and flake easily, usually about 3 to 5 minutes.

Oven-frying: Oven-frying is not actually a true frying method. It is a hot oven method which simulates fried fish. This method of cooking fish was developed by Evelene Spencer, a former Bureau Home Economist, and is sometimes referred to as the Spencer method.

For oven-frying, the fish are cut into serving-size portions, dipped in salted milk, and coated with toasted, fine, dry crumbs. The fish are then placed on a shallow, well-greased baking pan. A little melted fat or oil is poured over the fish, and they are baked in an extremely hot oven (550°F). Nice features of ovenfrying are that the fish don't require turning, basting, or careful watching, and the cooking time is short, usually 10 to 15 minutes. The crumb coating and the high temperature prevent the escape of flavorful juices and give an attractive, brown crust.

Pan-frying: Pan-frying is a term applied to cooking in a small amount of fat in a fry pan. Of all the ways of cooking fish, pan-frying is probably the most frequently used -- and most frequently abused method. When well controlled, it is an excellent way of cooking pan-dressed fish, fillets, and steaks.

The general procedure is to dip the fish in a liquid and then coat them with a breading. Heat about 1/8 inch of fat in the bottom of a heavy fry pan. For pans with a temperature control, the right heat is 350°F. Place one layer of breaded fish in the hot fat, taking care not to overload the pan and thus cool the fat. Fry until brown on one side, then turn and brown the other side. Cooking time will vary with the thickness of the fish. In general, allow about 8 to 10 minutes.

Poaching: Poaching is a method of cooking in a simmering liquid. In poaching, the fish are placed in a single layer in a shallow, wide pan, such as a large fry pan, and barely covered with liquid. The liquid used in poaching may be lightly salted water, water seasoned with spices and herbs, milk, or a mixture of white wine and water, to name just a few. As with other methods of fish cookery, it is important not to overcook the fish. Simmer the fish in the liquid in a covered pan just until the fish flakes easily, usually 5 to 10 minutes. Because the poaching liquid contains flavorful juices, the liquid is often reduced and thickened to make a sauce for the fish.

Poaching is a favorite method of cooking fish -- and with good reason. As an entree, poached fish can be simply served with a sauce or used as the main ingredient of a casserole or other combination dish. Chilled and flaked, poached fish makes a delicious salad.

Steaming: Steaming is a method of cooking fish by means of the steam generated from boiling water. When cooked over moisture in a tightly covered pan, the fish retain their natural juices and flavors. A steam cooker is ideal, but any deep pan with a tight cover is satisfactory. If a steaming rack is not available, anything may be used that prevents the fish from touching the water. The water used for steaming may be plain, or seasoned with various spices, herbs, or wine. When the water boils rapidly, the fish are placed on the rack, the pan is covered tightly, and the fish are steamed for 5 to 10 minutes or until they flake easily when tested with a fork. Steamed fish may be served the same as poached fish.

TABLE IV-D-1: TIMETABLE FOR COOKING FISH
(Courtesy Seafood Marketing Authority)

METHOD OF COOKING	MARKET FORM	AMOUNT FOR 6	COOKING TEMPERATURE	APPROXIMATE COOKING TIME (minutes)
Baking	Dressed	3 pounds	350° F.	45 to 60
	Pan-dressed	3 pounds	350° F.	25 to 30
	Fillets or steaks	2 pounds	350° F.	20 to 25
	Frozen fried fish portions	12 portions (2½ to 3 ounces each)	400° F.	15 to 20
	Frozen fried fish sticks	24 sticks (¾ to 1¼ ounces each)	400° F.	15 to 20
Broiling	Pan-dressed	3 pounds		10 to 16 (turning once)
	Fillets or steaks	2 pounds		10 to 15
	Frozen fried fish portions	12 portions (2½ to 3 ounces each)		10 to 15
	Frozen fried fish sticks	24 sticks (¾ to 1¼ ounces each)		10 to 15
Charcoal Broiling	Pan-dressed	3 pounds	Moderate	10 to 16 (turning once)
	Fillets or steaks	2 pounds	Moderate	10 to 16 (turning once)
	Frozen fried fish portions	12 portions (2½ to 3 ounces each)	Moderate	8 to 10 (turning once)
	Frozen fried fish sticks	24 sticks (¾ to 1¼ ounces each)	Moderate	8 to 10 (turning once)
Deep-Fat Frying	Pan-dressed	3 pounds	350° F.	3 to 5
	Fillets or steaks	2 pounds	350° F.	3 to 5
	Frozen raw breaded fish portions	12 portions (2½ to 3 ounces each)	350° F.	3 to 5
Oven-Frying	Pan-dressed	3 pounds	500° F.	15 to 20
	Fillets or steaks	2 pounds	500° F.	10 to 15
Pan-Frying	Pan-dressed	3 pounds	Moderate	8 to 10 (turning once)
	Fillets or steaks	2 pounds	Moderate	8 to 10 (turning once)
	Frozen raw breaded or frozen fried fish portions	12 portions (2½ to 3 ounces each)	Moderate	8 to 10 (turning once)
	Frozen fried fish sticks	24 sticks (¾ to 1¼ ounces each)		8 to 10 (turning once)
Poaching	Fillets or steaks	2 pounds	Simmer	5 to 10
Steaming	Fillets or steaks	1½ pounds	Boil	5 to 10

IV-E: BASIC SHELLFISH RECIPES

Boiled Blue Crabs

24 live, hard-shell, blue crabs
6 quarts boiling water
1/3 cup salt

Place crabs in boiling water. Cover and return to boiling point. Simmer for 15 minutes. Drain. Serve hot or cold. Serves 6.

Fried Soft-Shell Blue Crabs

12 soft-shell blue crabs	2 eggs, beaten
1/4 cup milk	2 teaspoons salt
3/4 cup flour	3/4 cup dry bread crumbs

Dress crabs by cutting off the face just back of the eyes. Remove the apron; remove the spongy parts (the gills, stomach, and intestines) under the points of the body covering. Rinse in cold water; drain. Combine egg, milk, and salt. Combine flour and crumbs. Dip crabs in egg mixture and roll in flour-and-crumb mixture.

Pan-Fried: Place crabs in a heavy frying pan which contains about 1/8 inch of fat, hot but not smoking. Fry at moderate heat. When crabs are brown on one side, turn carefully and brown the other side. Cooking time approximately 8 to 10 minutes. Drain on absorbent paper. Serves 6.

Deep-Fat Fried: Fry in a basket in deep fat, 375°F for 3 to 4 minutes or until brown. Drain on absorbent paper. Serves 6.

NOTE: A commercial breading may be used. Follow the directions on the package.

Baked Crab Meat in Shells

- 1 pound crab meat
- 1/4 cup butter or other fat, melted
- 1/2 cup milk
- 1/2 teaspoon salt
- 1/4 cup grated cheese
- 1/2 cup chopped onion
- 2 tablespoons flour
- 1/2 cup tomato sauce
- Dash pepper
- 1/2 cup soft bread crumbs

Remove any shell or cartilage from crab meat. Cook onion in butter until tender. Blend in flour. Add milk gradually and cook until thick, stirring constantly. Add tomato sauce, seasonings, and crab meat. Place in 6 well-greased, individual shells or 5-ounce custard cups. Combine cheese and crumbs; sprinkle over top of each shell. Bake in a moderate oven, 350°F for 20 to 25 minutes or until brown. Serves 6.

Broiled Crab Meat in Shells

- 1 pound crab meat
- 2 tablespoons lemon juice
- Dash cayenne pepper
- 1/3 cup butter or other fat, melted
- 1/4 teaspoon salt
- Chopped parsley.

Remove any shell or cartilage from crab meat. Combine butter, lemon juice, salt, cayenne pepper and crab meat. Place in 6 well-greased, individual shells or 5-ounce custard cups. Place on a broiler pan about 4 inches from source of heat. Broil for 7 to 10 minutes or until brown. Garnish with parsley sprinkled over top of each shell. Serves 6.

Crab Meat Salad

- 1 pound crab meat
- 2 tablespoons chopped onion
- 2 tablespoons chopped sweet pickle
- 1/2 teaspoon salt
- Lettuce
- 1/2 cup mayonnaise or salad dressing
- 1 cup chopped celery
- 2 hard-cooked eggs, chopped
- Dash pepper

Remove any shell or cartilage from crab meat, being careful not to break the meat into small pieces. Combine all ingredients except lettuce. Chill. Serve on lettuce. Serves 6.

BOILED LOBSTER

Live Whole Lobsters

2 live lobsters (1 pound each)
3 tablespoons salt
3 quarts boiling water
Melted butter

Plunge lobsters headfirst into boiling salted water. Cover and return to boiling point. Simmer for 20 minutes. Drain. Place lobster on its back. With a sharp knife cut in half length-wise. Remove the stomach, which is just back of the head, and the intestinal vein, which runs from the stomach to the tip of the tail. Do not discard the green liver and coral roe; they are delicious. Crack claws. Serve with butter. Serves 2.

For the recipes requiring cooked lobster meat, cool lobsters and remove meat. Two live lobsters, 1 pound each, yield approximately 1/2 pound cooked lobster meat.

Spiny Lobster Tails

6 frozen spiny lobster tails
 (5 to 8 ounces each)
1/3 cup salt
2 quarts boiling water
Melted butter

Place lobster tails in boiling salted water. Cover and return to boiling point. Simmer for 10 to 15 minutes, depending on size of lobster tails. Drain. Cut in half lengthwise. Serve with butter. Serves 6.

For the recipes requiring cooked lobster meat, cool spiny lobster tails and remove meat. One and one-half pounds frozen spiny lobster tails yield approximately 3/4 pound cooked lobster meat.

BROILED LOBSTERS

Live Whole Lobsters

2 live lobsters (1 pound each)
1 tablespoon butter, or margarine, melted
1/4 teaspoon salt
Dash white pepper
Dash paprika
1/4 cup butter or margarine melted
1 tablespoon lemon juice

Place lobster on its back; insert a sharp knife between body shell and tail segment, cutting down to sever the spinal cord. Cut in half lengthwise. Remove the stomach, which is just back of the head, and the intestinal vein, which runs from the stomach to the tip of the tail. Do not discard the green liver and coral roe; they are delicious. Crack claws. Lay lobsters open as flat as possible on a broiler pan. Brush lobster meat with butter. Sprinkle with salt, pepper, and paprika. Broil about 4 inches from source of heat for 12 to 15 minutes or until lightly browned. Combine butter and lemon juice; serve with lobsters. Serves 2.

Spiny Lobster Tails

6 frozen spiny lobster tails (5 to 8 ounces each)
1/3 cup butter or margarine, melted
1/2 teaspoon salt
Dash white pepper
Dash paprika
3/4 cup butter or margarine, melted
3 tablespoons lemon juice

Thaw lobster tails. Cut in half lengthwise. Lay lobster tails open as flat as possible on a broiler pan. Brush lobster meat with butter. Sprinkle with salt, pepper, and paprika. Broil about 4 inches from source of heat for 10 to 15 minutes, depending on size of lobster tails. Combine butter and lemon juice; serve with lobster tails. Serves 6.

HOW TO BOIL SHRIMP

Boiling is the basic method of cooking raw shrimp. The shrimp may be boiled, then peeled; or they may be peeled, then boiled. The order is largely a matter of personal preference; about the only difference is in the amount of salt used in the boiling water.

Either way, 1 1/2 pounds of raw shrimp yield about 3/4 pound of cooked, peeled, and cleaned shrimp, ready to eat immediately or to be chilled for later use in any of the recipes that call for cooked shrimp.

To boil before peeling

1 1/2 pounds shrimp
1 quart water
1/4 cup salt

Wash shrimp. Place in boiling salted water. Cover and return to boiling point. Simmer 5 minutes. Drain. Peel. Remove sand veins. Wash. Chill. Yields 3/4 pound cooked shrimp.

To boil after peeling

1 1/2 pounds shrimp
1 quart water
2 tablespoons salt

Peel shrimp. Make a shallow cut lengthwise down the back of each shrimp. Wash. Place in boiling salted water. Cover and return to boiling point. Simmer 5 minutes. Drain. Remove any particles of sand veins remaining. Chill. Yields 3/4 pound cooked shrimp.

Shrimp Salad

3/4 pound cooked shrimp (p. 2 or 3)	1 cup chopped celery
1 tablespoon grated onion	2 tablespoons chopped sweet pickle
1/2 teaspoon salt	Dash pepper
1/4 cup mayonnaise or salad dressing	Lettuce

Cut large shrimp in half. Combine all ingredients, except lettuce; chill. Serve on lettuce. Serves 6.

French-Fried Shrimp

1 1/2 pounds shrimp, fresh or frozen
1 teaspoon salt
1/2 cup dry bread crumbs
2 eggs, beaten
1/2 cup flour

Peel shrimp, leaving the last section of the shell on if desired. Cut almost through lengthwise and remove sand veins. Wash. Combine egg and salt. Dip each shrimp in egg, and roll in flour-and-crumb mixture. Fry in a basket in deep fat, 350°F for 2 to 3 minutes or until golden brown. Drain on absorbent paper. Serve plain or with a sauce. Serves 6.

NOTE: A commercial breading may be used. Follow the directions on the package.

Baked Oysters on the Half Shell

36 shell oysters
4 tablespoons butter
1/8 teaspoon pepper
2 tablespoons onion, minced
1/2 teaspoon salt

Shuck and drain oysters; place on deep half of shells. Sprinkle with salt, pepper, and onion. Dot with butter. Place oysters in baking pan, and bake in hot oven 400°F for 10 minutes or until edges begin to curl. Serves 6.

Fried Oysters

1 quart select oysters
2 tablespoons milk
1/8 teaspoon pepper
2 eggs, broken
1 teaspoon salt
1 cup bread crumbs, cracker crumbs, or cornmeal

Drain oysters. Mix eggs, milk, and seasonings. Dip oysters in egg mixture and roll in crumbs. Fry in hot fat; when brown on one side turn and brown other side. Cooking time about 5 minutes. Drain on absorbent paper. Serve immediately with slices of lemon or Tartar sauce. Serves 6.

Pan Roast Oysters

1 pint oysters	2 tablespoons butter
1/2 teaspoon salt	1/8 teaspoon pepper
Buttered toast	

Drain oysters, and place in shallow buttered baking dish. Melt butter, add seasonings and pour over oysters. Bake in hot oven 400°F aout 10 minutes or until edges begin to curl. Serve immediately on buttered toast. Serves 6.

Oyster Stew

1 pint oysters	4 tablespoons butter
1 quart milk	1 1/2 teaspoons salt
1/8 teaspoon pepper	Paprika

Melt butter, add drained oysters, and cook 3 minutes or until edges curl. Add milk, salt, and pepper, and bring almost to boiling point. Serve at once. Garnish with paprika. Serves 6.

Steamed Clams

6 pounds shell clams ("steamers")
1/2 cup boiling water
Butter or margarine

Wash clams thoroughly. Place in a steamer, add water, and cover. Steam for 5 to 10 minutes or until clams open. Serve hot in the shell with melted butter. Serves 6.

Roast Clams

6 pounds shell clams
Butter or margarine

Wash clams thoroughly. Place in a baking pan. Roast in a very hot oven, 450°F for 15 minutes or until clams open. Serve hot in the shell with melted butter. Serves 6.

Fried Clams

1 quart clams
1 tablespoon milk
Dash pepper
1 egg, beaten
1 teaspoon salt
1 cup dry bread crumbs or cracker crumbs

Drain clams. Combine egg, milk, and seasonings. Dip clams in egg mixture and roll in crumbs. Place clams in a heavy frying pan which contains about one-eighth inch of fat, hot but not smoking. Fry at moderate heat. When clams are brown on one side, turn carefully and brown the other side. Cooking time approximately 5 to 8 minutes. Drain on absorbent paper. Serve plain or with a sauce. Serves 6.

NOTE: A commercial breading may be used. Follow the directions on the package.

New England Clam Chowder

1 pint clams
1/4 cup chopped onion
1 cup diced potatoes
Dash pepper
Parsley
1/4 cup chopped bacon or salt pork
1 cup clam liquor and water
1/2 teaspoon salt
2 cups milk

Drain clams and save liquor. Chop. Fry bacon until lightly brown. Add onion and cook until tender. Add liquor, potatoes, seasonings, and clams. Cook about 15 minutes or until potatoes are tender. Add milk; heat. Garnish with chopped parsley sprinkled over the top. Serves 6.

Manhattan Clam Chowder

1 pint clams
1/2 cup chopped onion
1 cup chopped celery
1 cup diced potatoes
1 teaspoon salt
2 cups tomato juice
1/4 cup chopped bacon or salt pork
1/2 cup chopped green pepper
1 cup clam liquor and water
1/4 teaspoon thyme
Dash cayenne

Dain clams and save liquor. Chop. Fry bacon until lightly brown. Add onion, green pepper, and celery; cook until tender. Add liquor, potatoes, seasonings, and clams. Cook about 15 minutes or until potatoes are tender. Add tomato juice; heat. Serves 6.

Boiled Scallops

1 pound scallops, fresh or frozen
1 quart boiling water
2 tablespoons salt

Thaw frozen scallops. Remove any shell particles and wash. Place in boiling salted water. Cover and return to the boiling point. Simmer for 3 to 4 minutes, depending on size. Drain. Serves 6.

For recipes requiring cooked scallops, 1 pound scallops, fresh or frozen, yields approximately 1/2 pound cooked scallops.

Broiled Scallops

1 1/2 pounds scallops, fresh or frozen
1/2 teaspoon salt
Dash paprika
3/4 cup butter or margarine, melted
1/3 cup butter or margarine, melted
Dash white pepper
2 tablespoons chopped parsley
3 tablespoons lemon juice

Thaw frozen scallops. Remove any shell particles and wash. Cut large scallops in half. Place on a greased broiler pan. Combine butter, salt, pepper, and paprika. Brush scallops with seasoned butter. Broil about 3 inches from source of heat for 3 to 4 minutes. Turn carefully. Brush other side with seasoned butter and broil 3 to 4 minutes longer. Sprinkle with parsley. Combine butter and lemon juice; serve with scallops. Serves 6.

Fried Scallops

2 pounds scallops, fresh or frozen
1 tablespoon milk
Dash pepper
1/2 cup dry bread crumbs
1 egg, beaten
1 teaspoon salt
1/2 cup flour

Thaw frozen scallops. Remove any shell particles and wash. Cut large scallops in half. Combine egg, milk, and seasonings. Combine flour and crumbs. Dip scallops in egg mixture and roll in flour-and-crumb mixture.

NOTE: A commercial breading may be used. Follow the directions on the package.

Pan-Fried: Place scallops in a heavy frying pan which contains about 1/8 inch of fat, hot but not smoking. Fry at moderate heat. When scallops are brown on one side, turn carefully and brown the other side. Cooking time approximately 4 to 6 minutes. Drain on absorbent paper. Serves 6.

Deep-Fat Fried: Fry scallops in a basket in deep fat, 350°F for 2 to 3 minutes or until brown. Drain on absorbent paper. Serves 6.

IV-F: BASIC FINFISH RECIPES

Broiled Fillets or Steaks

2 pounds fish fillets or steaks, fresh or frozen
2 tablespoons melted fat or oil
1/2 teaspoon paprika
2 tablespoons lemon juice
1 teaspoon salt
Dash pepper

Thaw frozen fish. Cut fish into 6 portions. Place fish in a single layer, skin side down, on a well-greased baking pan, 15 by 10 by 1 inches. Combine remaining ingredients and mix well. Pour sauce over fish. Broil about 4 inches from source of heat for 10 to 15 minutes or until fish flake easily when tested with a fork. Baste once during broiling with sauce in pan. Makes 6 servings.

Broiled Pan-Dressed Fish

3 pounds pan-dressed fish, fresh or frozen
1/4 cup melted fat or oil
1/4 cup lemon juice
1 1/2 teaspoons salt
3/4 teaspoon paprika
Dash pepper

Thaw frozen fish. Cut fish into 6 portions. Place fish in a single layer, skin side down, on a well-greased baking pan, 15 by 10 by 1 inches. Combine remaining ingredients and mix well. Brush fish inside and out with sauce. Broil about 4 inches from source of heat for 5 to 8 minutes. Turn carefully and baste with sauce. Broil 5 to 8 minutes longer or until fish flake easily when tested with a fork. Makes 6 servings.

Baked Stuffed Fish

1 dressed fish (3 pounds fresh or frozen)
Salt
2 tablespoons melted fat or oil
Pepper
Bread stuffing

Thaw frozen fish. Clean, wash, and dry fish. Sprinkle inside with salt and pepper. Place fish on a well-greased bake and serve platter, 18 by 13 inches. Stuff fish loosely. Brush fish with fat. Bake in a moderate oven, 350°F for 45 to 60 minutes or until fish flakes easily when tested with a fork. Makes 6 servings.

Bread Stuffing

1/2 cup chopped celery
1/4 cup chopped onion
1/4 cup butter or margarine, melted
1 quart dry bread cubes
Dash pepper
1 egg, beaten
1/2 teaspoon sage
1/2 teaspoon salt
1/4 teaspoon thyme

Cook celery and onion in butter until tender. Combine all ingredients and mix well. Makes 3 cups stuffing.

Fried Pan-Dressed Fish

3 pounds pan-dressed fish, fresh or frozen
1/4 cup milk
1 egg, beaten
1 teaspoon salt
Dash papper
1 1/2 cups dry bread, cereal or cracker crumbs
Fat for frying

Thaw frozen fish. Clean, wash, and dry fish. Combine milk, egg, salt, and pepper. Dip fish in milk and roll in crumbs. Place fish in a single layer in hot fat, in a 10-inch fry pan. Fry at a moderate heat for 4 to 5 minutes or until brown. Turn carefully. Fry 4 to 5 minutes longer or until fish are brown and flake easily when tested with a fork. Drain on absorbent paper. Makes 6 servings.

Barbecued Fillets or Steaks

2 pounds fish fillets or steaks, fresh or frozen

1/4 cup chopped onion

2 tablespoons chopped green pepper

1 clove garlic, finely chopped

2 tablespoons melted fat or oil

1/4 teaspoon pepper

1 can (8 ounces) tomato sauce

2 tablespoons lemon juice

1 tablespoon Worcestershire sauce

1 tablespoon sugar

2 teaspoons salt

Thaw frozen fish. Cook onion, green pepper, and garlic in fat until tender. Add remaining ingredients and simmer for 5 minutes, stirring occasionally. Cool. Cut fish into 6 portions. Place fish in a single layer in a shallow baking dish. Pour sauce over fish and let stand for 30 minutes, turning once. Remove fish, reserving sauce for basting. Place fish in well-greased, hinged, wire grills. Cook about 4 inches from moderately hot coals for 5 to 8 minutes. Baste with sauce. Turn. Cook for 5 to 8 minutes longer or until fish flake easily when tested with a fork. Makes 6 servings.

Deep-Fat Fried Fillets or Steaks

2 pounds fish fillets or steaks, fresh or frozen

1/4 cup milk

1 egg beaten

1 teaspoon salt

Dash pepper

1 1/2 cups dry bread, cereal, or cracker crumbs

Fat for frying

Thaw frozen fish. Cut fish into 6 portions. Combine milk, egg, salt, and pepper. Dip fish in milk and roll in crumbs. Place in a single layer in a fry basket. Fry in deep fat, 350°F for 3 to 5 minutes or until fish are brown and flake easily when tested with a fork. Drain on absorbent paper. Makes 6 servings.

NOTE: A commercial breading may be used. Follow the directions on the package.

Oven-Fried Fillets or Steaks

2 pounds fish fillets or steaks, fresh or frozen
1 teaspoon salt
1/4 cup melted fat or oil
1/2 cup milk
1 1/2 cups cereal crumbs or toasted dry bread crumbs

Thaw frozen fish. Cut fish into 6 portions. Combine milk and salt. Dip fish in milk and roll in crumbs. Place fish in a single layer, skin side down, on a well-greased baking pan, 15 by 10 by 1 inches. Pour fat over fish. Bake in an extremely hot oven, 500°F for 10 to 15 minutes or until fish are brown and flake easily when tested with a fork. Makes 6 servings.

Poached Fish with Egg Sauce

2 pounds fish fillets or steaks, fresh or frozen
2 cups boiling water
1/4 cup lemon juice
1 small onion, thinly sliced
1 teaspoon salt
3 peppercorns
2 sprigs parsley
1 bay leaf
Egg sauce
Paprika

Thaw frozen fish. Remove skin and bones from fish. Cut fish into 6 portions. Place fish in a well-greased 10-inch fry pan. Add remaining ingredients. Cover and simmer for 5 to 10 minutes or until fish flake easily when tested with a fork. Carefully remove fish to a hot platter. Pour Egg Sauce over the fish. Sprinkle with paprika. Makes 6 servings.

Egg Sauce:

1/4 cup butter or margarine
2 tablespoons flour
3/4 teaspoon powdered mustard
1/2 teaspoon salt
Dash pepper
1 1/4 cups milk
2 hard-cooked eggs, chopped
1 tablespoon chopped parsley

Melt butter. Stir in flour and seasonings. Add milk gradually and cook until thick and smooth, stirring constantly. Add eggs and parsley. Heat. Makes 1 1/2 cups sauce.

Steamed Fish

1 1/2 pounds fish fillets, steaks, or pan-dressed fish, fresh or frozen	1 quart boiling water
1 1/2 teaspoons salt	

Thaw frozen fish. Place fish in a well-greased steamer insert pan. Sprinkle fish with salt. Cover and cook over boiling water for 5 to 10 minutes or until fish flake easily when tested with a fork. Cool. Remove skin and bones. Makes 2 cups cooked fish.

Rainy Day Casserole

2 pounds fish fillets (fresh or frozen)	1 can cream of tomato soup (10 3/4 ounces)
2 tablespoons chopped onion	3/4 teaspoon salt
Pepper to season	1 cup grated cheese
1 baking dish or pan (about 12 x 8 x 2 inches)	

If the fish fillets are frozen, let them thaw. Heat the oven to 350 degrees (350°F). Cut the fish fillets into 6 servings. Rub the baking dish well with fat. Put the fish in the baking dish. Mix the soup, onion, salt, and pepper. Spread the soup mixture over the fish. Sprinkle the grated cheese over the soup mixture. Bake the fish for 25 to 30 minutes or until cooked. Test the fish with a fork. The fish is cooked when it falls apart easily. Serves 6.

IV-G: SAUCES

Cocktail Sauce 1

1/2 cup catsup
1 tablespoon grated onion
1 teaspoon Worcestershire sauce
Dash pepper
2 tablespoons lemon juice
2 tablespoons mayonnaise or salad dressing
1/4 teaspoon salt

Combine all ingredients and chill. Serves 6.

Cocktail Sauce 2

3/4 cup chili sauce
1 tablespoon lemon juice
1/2 teaspoon salt
1/4 cup finely chopped celery
1 tablespoon horseradish

Combine all ingredients and chill. Serves 6.

Cocktail Sauce 3

1/2 cup catsup
1 tablespoon horseradish
1/2 teaspoon celery salt
6 tablespoons lemon juice
3 drops tabasco sauce
1/4 teaspoon salt

Blend all ingredients and chill. Serves 6.

Cocktail Sauce 4

1/3 cup mayonnaise or salad dressing
2 teaspoons lemon juice
1/4 teaspoon paprika
1/4 teaspoon salt

Combine all ingredients and chill. Serves 6.

Tartar Sauce

1/2 cup mayonnaise
1 tablespoon pickles, minced
1 tablespoon olives, minced
1 tablespoon onion, minced
1 tablespoon parsley, minced

Mix thoroughly and chill.

Clam Dip

1 can (7 ounces) minced clams
2 packages (3 ounces each) cream cheese
1/4 teaspoon salt
2 teaspoons grated onion
Potato chips
1 teaspoon Worcestershire sauce
3 drops tabasco
2 teaspoons lemon juice
1 teaspoon chopped parsley

Drain clams. Save liquor. Soften cheese at room temperature. Combine all ingredients except potato chips and liquor; blend into a paste. Gradually add about 1/4 cup clam liquor and beat until consistency of whipped cream. Chill. Serve in a bowl surrounded by potato chips. Makes about 1 pint dip.

IV-H: GARNISHES

The importance of garnishes cannot be emphasized too much. A dash of color or a touch of garnish can turn a plain dish into an attractive and appetizing one. The most common garnishes are listed below together with suggested methods of preparation.

GARNISHES	SUGGESTED PREPARATION
Beets	Cooked whole or sliced
Carrots	Tops, sticks, curls or shredded
Chives	Chopped
Cucumbers	Slices or sticks
Dill	Sprigs or chopped
Green or red peppers	Sticks or rings
Hard-cooked eggs	Slices, wedges, deviled, or graded yolks
Lemons or limes	Slices, twists, or wedges
Lettuce	Leaves or shredded
Mint	Sprigs or chopped
Nut meats	Toasted whole, halved, slivered, or chopped
Olives	Whole, sliced, or chopped
Oranges	Slices, twists, or wedges
Paprika	Sprinkled sparingly
Parsley	Sprigs or chopped
Pickles	Whole, sliced, or chopped
Radishes	Whole, sliced, or roses
Water cress	Sprigs or chopped

PART V: COMPOSITION AND NUTRITION

V-A: FISH AND SEAFOOD - COMPOSITION AND NUTRITIONAL ASPECTS

by Virginia D. Sidwell

Throughout the ages, seafood has been one of man's chief sources of animal protein. Ancient Egyptians processed fish by sun-drying, salting, or both, in order to preserve a constant supply. Early Romans had fish ponds where they kept the animals until preparation time. Wherever man lives near water and is assured a supply of protein, there is no evidence of malnutrition due to the lack of protein.

Calories

Fishery products with no added sauces are low in calories. A 100-gram raw edible portion of a low-fat fish such as haddock or cod will contain about 80 calories; a high-fat fish such as bluefish or mullet about 120 calories.

Protein

The amount of protein in a species of fish varies with feeding habits, age and sex of the fish, and fat and water content of the flesh. On the average, the muscle of finfish will contain 18 - 22 grams (g) of protein per 100 g of edible portion. Mollusks contain less protein and crustaceans more than the finfish. The protein content of the various muscles in the fish body is not always the same. For example, the white muscle of the albacore will be higher in protein than the dark meat, which contains more fatty tissue. The nutritive value of the protein in fish flesh is equal to or better than milk protein (casein). Unless fish is badly handled during processing or cooking, the nutritive quality of the protein does not change markedly. There is scientific evidence that fish muscle is highly digestible. All of the essential amino acids needed for man's good protein nutrition are present in fish muscle. It is high in lysine and therefore is a good supplement to a cereal diet. All of man's protein requirements may be met by a diet with fish as its sole protein source.

Water

Average finfish and some shellfish contain 80 to 85 percent water, with the extreme values ranging from 53 to 90 percent. Mollusks contain more water than finfish or crustaceans. The amount of water in some animals will vary with season. Before spawning, finfish will be high in fat content and low in water, and at other times the reverse ratio prevails.

Fat

The chemical composition of the lipid content of fish flesh differs from that of most other naturally-occurring oils and fats in: (1) having a greater variety of lipid compounds, (2) possessing larger quantities of fatty acids with chain lengths exceeding 18 carbons, (3) containing a much greater proportion of highly unsaturated fatty acids, and (4) having polyunsaturates, primarily at the W3 rather than W6 position. The lipid content of a species of fish will vary with season, geographic origin, prevailing temperatures of the environment, physiological status of the animal (pre- or post-spawning) and its available food. There is an inverse relationship between the water, protein, and fat content of fish flesh. When the fat content is high, the moisture level and protein content will be lower. The amounts and character of the fatty acids vary with the different organs and parts of the fish. For example, the liver oils contain different lipids than do the dark or the white meats.

These polyunsaturated fatty acids have important nutritional roles. Fish lipids contain 2 to 9% linoleic acid, which is needed for growth and for the maintenance of normal integrity. The linolenic acid of the W3 series not only supports growth, but also functions in the transport of lipoid material such as cholesterol.

The lipids may be divided into 2 parts: (1) saponifiables, which contain the mono-, di- and tri-glycerides; (2) non-saponifiables, containing the fat-soluble vitamins, A, D and E, steroids, and phospholipids. The variation in the amount of non-saponifiable material is small and somewhat constant. Changes in the amount of lipid content of fish flesh are mainly due to variation in the amount of triglycerides.

Ash

In the edible portion of fishery products the percent ash varies from 0.4-1.5 g/100g. The amount present is clearly associated with the amount of skin and bones present in the samples of fish muscle. Small fish such as herring or smelt are often utilized whole and therefore their ash content approximates 3-4 g/100g. In processed fish the ash will be high, since salt is often used in the canning or drying procedures.

Ash in fish muscle contains nutritionally important minerals. Sodium and potassium play a significant role in cellular physiology. Values reported in literature range from 30-150 milligrams (mg) for sodium with an average of 60 mg/100g of fish muscle, and 250-500 mg with an average of 400 mg for potassium. Fresh-water fish are somewhat lower in sodium than salt-water fish, 34-96 mg in salt-water fish and 38-84 mg/100g in fresh water fish. The corresponding figures for potassium are 240-400 mg in flesh of marine species and 133-440 mg/100g of fresh water fish. Some species from different areas show differences in sodium content; for example, whiting from the Atlantic Ocean contain 82 mg/100g compared to 65 mg for the Pacific Ocean whiting. These elements also vary with size and season. Some fishery technologists postulate that the variation in sodium and potassium may be associated with life cycle (pre- or post-spawning). In crustaceans and mollusks, the sodium content in the flesh is higher, but the potassium tends to be lower than in the teleosts.

Values for calcium range from 5-200 mg with an average of 30 mg/100g of fish flesh; for phosphorus 100-400 mg with an average of 220 mg. This variability may be related to a number of factors, such as the amount of calcium and phosphorus present in the water and/or food, age, size, or sexual maturity of the animal. These minerals are much higher in whole fish; in fact, whole fish is a nutritionally excellent source of calcium. Crustaceans and mollusks tend to contain more calcium and less phosphorus in the muscle tissue than do the finfish.

Magnesium is another important dietary nutrient for it activates the enzyme system which functions in the metabolism of carbohydrates to produce energy. Fish is a good source of magnesium. The amount found in the flesh is associated with the amount in the food chain. It is not known whether the animal accumulates this element in its muscle or reaches a saturation point at which the magnesium content levels off.

Fish flesh contains most of the elements present in sea water. Some are nutritionally important: iron, copper, iodine, fluorine, cobalt, zinc, chromium and vanadium. The amount of each of these elements present in fish is determined by such variables as the amount present in the food chain, and the size and age of the animal. Also, certain species of fish have a tendency to accumulate more of some of the elements than do others.

Iron and copper are important elements needed for good nutrition. They are needed by the body to synthesize hemoglobin. There is about one mg of iron (0.4-5 mg) /100 g of fish flesh. Dark meat is richer in iron than is white meat. Also, fresh-water fish contain less iron then do marine species. No information is available as to whether the iron in fish is biologically available. If it is, then fish flesh is a good source of iron. The amounts of copper in fish flesh range from 0.04-0.6 mg/100g with an average of 0.25 mg. Crustaceans and mollusks contain more iron and copper than finfish.

Seafood is the richest natural source of iodine, which is nutritionally important for the maintenance and function of the thyroid gland in the production of thyroxine. It is difficult to give an overall average amount that can be expected to be present in the flesh of fish. For marine species of finfish the values range from 16-318 micrograms (μg), for fresh water fish 1.7-40 μg/100g of flesh. Iodine seems to concentrate in the oil fraction of the fish. In fatty fish, the iodine is found to a greater extent in the skin than in the muscle. The reverse situation appears in the lean fish.

Fluorine is found in the skeleton rather than in the muscle of fish. Marine species have larger amounts of fluorine than do fresh water species. Limited data are available. The values range from 0.5-1.0 mg/100g of flesh. A small amount of this element is needed to prevent cavities in growing children, and to prevent brittleness in the bones of the aged.

Cobalt is a component of the molecular structure of vitamin B_{12}. Zinc is present in the cells of all living organisms and is especially plentiful in marine organisms. The element functions in many enzymatic systems and therefore has a predominant role in carbohydrate and protein metabolism. In finfish flesh the amount of zinc ranges from 0.7-30 mg/100g, the amount present in the environment playing a great role in the exact concentration. Shellfish tend to concentrate zinc in larger quantities than those needed by the organism (1.2-26.0 mg/100g).

More so in marine than in freshwater animals, a number of nutritionally important elements are found in trace amounts, for example, chromium and vanadium. In man, minute amounts of vanadium are found in the bony and fatty tissues. There is also some experimental evidence that vanadium interferes with the synthesis of cholesterol. Chromium functions in glucose and fat metabolism.

There are some elements that may be toxic to man if ingested in large amounts. Mercury is one. Mercury, per se, is not absorbed from the gut, but the mercury compound methylmercury is; therefore, the Food and Drug Administration has set a guideline of 0.5 parts per million (ppm) for the allowable amount of mercury present in food. The presence of selenium has been shown to interfere with the absorption of methylmercury. Little is known about this relationship. Arsenic is another element that falls into this category. The amount of arsenic found in seafood flesh is closely associated with the amount present in the environment. Metallic arsenic is far more toxic than the organic form of the metal. It has been shown in animal studies that arsenic in shrimp is by far less toxic than the inorganic form. Cadmium is another metal that may be toxic to man. So little is actually known about these toxic metals that no clear conclusions can be drawn.

Vitamins

There are indications that the vitamin content in fish muscle varies with species, age, season, sexual maturity and geographical areas. No extensive studies have been published on the vitamin content in the various species of fish flesh. There is an abundance of information on the fat-soluble vitamins A and D in fish liver oil.

Most of the vitamin A and D is found in the viscera, especially the liver; very little, if any, in the flesh. The vitamin A content of fish flesh ranges from 0-18000 international units (IU) per gram of tissue. Cod, herring, and ocean perch contain negligible amounts of vitamin A in their flesh, even when the liver contains large amounts of the vitamin. However, lamprey, eel, shark and conger eel contain more vitamin A in the flesh than in the viscera. White meat contains less vitamin A than dark flesh. In general, there is very little or no vitamin D in fish flesh. The content is somewhat dependent upon the species. For example, there is very little vitamin D in the flesh of yellow tail and flatfish, while sardine and mackerel contain a higher level. Information on the vitamin E or K content in the muscle tissue is sparse. The gonads are rich in vitamin E, which may be connected with spawning activities. Potency varies from a high level before spawning to a low one after spawning.

Some important members of the water-soluble vitamins which exist in fish flesh include thiamine, riboflavin, pryidoxine, niacin, folic acid, pantothenic acid, B_{12}, and vitamin C. The distribution of these vitamins in the body of the marine animals is not like that of the fat-soluble vitamins which concentrate in the viscera. The water-soluble vitamins are more evenly dispersed throughout the body.

Thiamine (B_1) content in fish flesh ranges from 0 μg in carp and suckers to 660 μg in flounder, with an average of approximately 100 μg/100g of fish muscle. The presence of thiaminase should be considered whenever certain fish such as carp, mackerel, or sardine are being fed to terrestrial animals. In this case, the fish should be thoroughly cooked to destroy the enzyme. No process except cooking will destroy its activity.

The amount of riboflavin (B_2) in fish is far more variable than the amount of thiamine. Riboflavin functions in the co-enzyme systems that participate in metabolism and growth of animals. This physiological activity is not as clearly documented in marine as in terrestrial animals. Dark meat contains more riboflavin than white. The amounts of this vitamin in the flesh of cod, haddock, mackerel, salmon, smelt and tuna are comparable to those found in the meat of terrestrial animals, 50-980 μg/100g of muscle.

Again, the real function of pyridoxine (B_6) in fish has not been clarified as for mammalian organisms. It plays a vital role in general fat metabolism, that is, the conversion of carbohydrate and protein into fat. Whole fish is a good source of pyridoxine. The range of values is 100-1200 μg/100g of fish flesh. The fish-spoiling bacteria produce large amounts of vitamin B_6 during their activity and consequently it is difficult to determine the real biochemical role of this vitamin in fish metabolism.

Fish muscle is a good source of niacin. The amounts range from 0.9-3.1 mg/100g of tissue. The amount of niacin in the flesh appears to be associated with the degree of mobility exhibited by each species of fish. Those with greater locomotive power carry more niacin than species with poor locomotion.

Seafood contains significant amounts of vitamin B_{12}, especially the fatty fish and shellfish. The potency of the vitamin is higher in dark flesh fish such as herring and sardine, than in white flesh such as that of cod or flatfish. The amount in fish muscle ranges from 0, as in shark, to 1.9 μg/100g in Pacific herring. Since this vitamin is synthesized by microorganisms, fermented fish products are a rich source of vitamin B_{12}.

Very little is known about the physiological function of pantothenic acid in fish. Muscle tissue contains the least amount of pantothenic acid. The values range from 0-1400 μg/100g of tissue. The variation is quite small within species, but it's the reverse between species. The greatest concentration is found in the gonads; therefore it may be associated with the reproductive system. Like most of the other B-vitamins, the concentration is higher in the dark meat than in white.

The edible portion of fish muscle is not always a rich source of folic acid. It is concentrated in the kidney, liver, and spleen. The values for a select number of fish range from 0 for grouper to 11 μg for mullet and Arctic cod per 100 g of muscle tissue. There is a negligible amount of vitamin C in the edible portion of fish. Most of it is found in the vital organs of the animal.

REFERENCES

Borgstrom, George. 1961. Fish as Food. Volumes I and II. Academic Press Inc. New York.

Heen, Eirik and Kreuzer, Rudolf. 1962. Fish in Nutrition. Fishing News (Books) Ltd. London.

Love, R. M. 1957. The Biochemical Composition of Fish. In The Physiology of Fish, Margaret E. Brown, Editor. Academic Press Inc. New York.

V-B: SEAFOOD COMPOSITION TABLES

The tables that follow are the result of extensive analyses by researchers for the National Marine Fisheries Service. In each table, the left-hand column lists the individual species analyzed. The other columns list the compositional milligrams per hundred grams. Dashes represent information that is not available.

The charts are composed of groups containing three figures. In each group, the first figure is the mean (average) followed by the standard error. The second figure is the range of values found, from lowest to highest. The third figure is the number of analyses made for that particular species. Thus, in the first table we find that Haddock contains 79% moisture (plus or minus 0.2 g), with individuals ranging from 78 to 80.7% in 20 analyses.

TABLE V-B-1: PROXIMATE COMPOSITION, CALCIUM, AND PHOSPHORUS CONTENT OF THE EDIBLE PORTIONS OF RAW FINFISH

Fresh finfish	Proximates				Minerals	
	Moisture g%	Crude protein g%	Ash g%	Ether fat g%	Ca mg%	P mg%
Catfish (Cultured)	*77.4±0.1	20.5±0.7	1.53±0.09	0.65±0.32	64±8	228±14
Ictalurus punctatus	**74.5-80.7	17.0-23.9	1.10-1.94	0.09-2.31	20-90	130-240
	***10	10	10	8	9	9
Catfish (Wild)	79.4±0.2	18.2±0.3	1.19±0.02	0.96±0.11	27±2	214±8
Ictalurus punctatus	77.9-80.0	16.3-19.7	1.09-1.25	0.51-1.51	19-37	158-298
	10	10	10	9	9	15
Cod (Icelandic)	81.4±0.2	18.1±0.2	1.20±0.02	0.10±0.02	22±1	192±7
Gadus morhua	79.0-83.1	16.7-19.6	1.01-1.36	0.01-0.26	18-30	150-240
	22	20	20	20	16	15
Cod (Inshore-Domestic)	80.1±0.3	19.6±0.3	1.26±0.04	0.12±0.02	42±5	222±6
Gadus morhua	76.8-83.3	16.3-21.8	0.96-1.84	0.00-0.30	19-80	180-270
	23	24	20	20	16	18
Flounder, Yellowtail	76.5±0.3	22.3±0.4	1.21±0.04	0.37±0.06	27±2	203±12
Limanda ferruginea	74.1-78.7	18.8-25.5	1.05-1.76	0.05-1.16	20-40	170-300
	20	20	20	19	14	12
Haddock (inshore)	79.0±0.2	20.4±0.3	1.50±0.05	0.11±0.01	62±7	211±13
Melanogrammus aeglefinus	78.0-80.7	16.7-22.6	1.12-1.87	0.03-0.23	20-90	150-350
	20	20	21	20	11	20
Hake, Pacific	80.1±0.2	18.4±0.4	1.25±0.04	0.69±0.10	28±3	176±5
Merluccius productus	78.7-81.1	16.2-22.4	1.00-1.59	0.20-1.50	20-50	150-200
	18	18	18	17	17	15
Halibut, Pacific	77.5±0.4	20.1±0.3	1.27±0.02	1.22±0.23	47±6	221±8
Hippoglossus stenolepsis	76.6-80.9	18.1-22.9	1.14-1.49	0.43-3.90	20-78	160-260
	23	21	21	19	13	16
Perch, Ocean	77.3±0.3	21.7±0.3	1.45±0.03	0.81±0.11	141±7	223±6
Sebastes marinus	75.8-80.2	19.6-24.8	1.18-1.71	0.10-1.44	80-190	160-270
	21	19	22	17	21	23
Pollock	77.7±0.2	20.9±0.2	1.47±0.06	0.15±0.03	87±12	228±10
Pollachius virens	75.8-80.6	19.2-22.5	1.12-2.01	0.0-0.51	30-150	160-300
	22	23	20	20	11	16
Rockfish, Pacific	79.7±0.2	19.8±0.3	1.26±0.03	0.53±0.10	39±5	214±7
Sebastes sp.	78.0-81.3	18.0-22.6	1.07-1.42	0.03-1.58	20-90	160-250
	22	22	20	19	9	12
Snapper, Red	76.0±0.2	22.4±0.1	1.31±0.02	0.41±0.08	28±4	210±8
Lutjanus blackfordii	73.8-77.7	20.9-23.6	1.16-1.55	0.09-1.36	20-50	160-240
	24	23	20	21	15	19
Whiting	78.7±0.4	17.8±0.2	1.26±0.03	2.43±0.22	72±6	221±11
Merluccius bilinearis	75.6-80.9	16.3-19.5	1.00-1.53	0.78-4.76	50-100	150-290
	22	25	21	20	11	13

*Mean and standard error of the mean.
**Range.
***Number of analyses.

TABLE V-B-2: PROXIMATE COMPOSITION, CALCIUM, AND PHOSPHORUS CONTENT OF THE EDIBLE PORTIONS OF CANNED FINFISH

Canned finfish	Proximates				Minerals	
	Moisture g%	Crude protein g%	Ash g%	Ether fat g%	Ca mg%	P mg%
Salmon, Sockeye	*71.3±0.2	21.0±0.2	2.35±0.11	6.04±0.13	22±1	273±10
Oncorhynchus nerka	**69.3-72.5	19.3-22.1	1.55-3.03	5.20-7.08	19-28	180-340
	***16	20	17	16	9	17
Tuna, Yellowfin (canned in oil)	59.9±0.4	22.9±0.5	1.91±0.05	15.2±0.4	37±7	224±5
	57.9-62.2	19.3-24.3	1.51-2.11	13.0-17.7	20-67	190-260
Thunnus albacares	14	12	12	11	7	15
Tuna, Yellowfin (canned in brine)	74.8±0.4	24.0±0.2	1.48±0.12	0.81±0.08	33±9	195±12
	73.1-76.5	23.3-24.8	1.14-1.92	0.43-1.04	20-50	180-230
Thunnus albacares	8	8	8	8	3	4

*Mean and standard error of the mean.
**Range.
***Number of analyses.

TABLE V-B-3: PROXIMATE COMPOSITION, CALCIUM, AND PHOSPHORUS CONTENT OF THE EDIBLE PORTIONS OF RAW CRUSTACEANS

Crustaceans	Proximates				Minerals	
	Moisture g%	Crude protein g%	Ash g%	Ether fat g%	Ca mg%	P mg%
Crab, Blue	*77.4±0.3	19.8±0.1	2.06±0.04	1.02±0.07	102±12	272±10
Callinectes sapidus	**75.2-80.6	18.4-21.0	1.81-2.46	0.55-1.58	22-180	200-370
	***22	22	22	20	13	16
Crab, King (body)	79.2±0.3	18.3±0.2	1.60±0.05	0.38±0.02	42±3	212±10
Paralithodes camschatica	76.7-81.4	17.0-19.5	1.19-1.83	0.24-0.54	21-69	180-273
	16	16	16	16	24	25
Crab, King (leg)	76.8±0.07	20.1±0.5	1.81±0.06	0.40±0.03	55±4	228±10
Paralithodes camschatica	69.2-79.3	17.2-24.9	1.28-2.52	0.22-0.67	40-80	160-320
	17	18	18	18	12	18
Lobster, Spiny	75.6±0.3	23.1±0.2	1.71±0.02	0.33±0.03	47±4	237±11
Panulirus argus	74.2-79.0	22.0-25.6	1.51-1.96	0.17-0.55	20-80	150-320
	23	20	20	15	18	19
Shrimp, Alaskan	77.4±0.3	20.1±0.4	2.26±0.14	0.64±0.02	49±4	187±4
Mixed spp.	75.5-79.7	16.7-26.2	1.41-3.77	0.44-0.85	40-80	170-210
	20	22	19	20	14	12
Shrimp, Asian	84.0±0.4	15.2±0.4	0.77±0.03	0.42±0.17	68±5	181±10
Mixed spp.	81.0-87.3	13.1-18.8	0.53-0.96	0.12-3.00	30-90	130-230
	20	20	21	16	14	10
Shrimp, Brown	76.2±0.1	21.4±0.2	1.63±0.01	0.14±0.01	59±2	248±5
Penaeus aztecus	75.2-76.5	17.2-23.3	1.54-1.72	0.05-0.28	40-80	220-290
	20	23	20	20	19	18
Shrimp, Maine	81.5±0.5	17.1±0.4	1.30±0.06	0.39±0.05	54±4	177±9
Pandalus borealis	77.9-86.0	13.5-20.2	0.93-1.86	0.12-0.82	40-80	150-270
	19	23	20	19	11	14
Shrimp, Mexican	80.4±0.3	18.1±0.3	1.40±0.04	0.18±0.03	95±2	176±4
Mixed spp.	78.5-82.5	16.5-20.6	1.14-1.68	0.06-0.55	70-120	150-210
	22	23	20	18	14	18
Shrimp, White (Gulf)	77.4±0.2	20.6±0.1	1.41±0.02	0.20±0.02	50±1	233±9
Penaeus setiferus	76.4-78.7	19.5-21.6	1.26-1.57	0.05-0.40	40-60	150-290
	20	21	20	20	20	17
Shrimp, White	76.2±0.2	22.0±0.2	1.90±0.05	0.17±0.02	64±3	281±11
(South Atlantic)	75.3-79.5	20.9-23.5	1.86-2.03	0.06-0.26	50-90	160-350
Penaeus setiferus	22	20	20	15	17	17

*Mean and standard error of the mean.
**Range.
***Number of analyses.

TABLE V-B-4: PROXIMATE COMPOSITION, CALCIUM, AND PHOSPHORUS CONTENT OF THE EDIBLE PORTIONS OF RAW MOLLUSCA

Mollusca	Proximates				Minerals	
	Moisture g%	Crude protein g%	Ash g%	Ether fat g%	Ca mg%	P mg%
Clams (Hard Shell)	*91.8±0.1	4.41±0.17	1.97±0.02	0.21±0.02	65±3	69±3
Marcenaria mercenaria	**90.8-92.5	3.20-6.24	1.79-2.16	0.10-0.42	20-91	50-130
	***20	19	20	20	31	26
Clams (Soft Shell)	83.3±0.9	9.51±0.43	1.19±0.09	1.27±0.16	53±3	152±6
Mya arenaria	76.6-90.8	5.48-11.68	0.62-1.99	0.42-2.64	17-73	110-206
	20	20	17	20	27	24
Clams (Surf)	79.4±0.2	15.6±0.1	2.29±0.10	0.34±0.06	41±3	194±5
Spisula solidissima	78.2-80.9	14.6-16.7	1.10-3.05	0.10-0.87	17-80	110-265
	20	20	20	20	31	36
Oysters (Long Island)	85.4±0.2	7.86±0.23	1.11±0.02	1.13±0.07	52±3	145±6
Crassostrea virginica	82.5-86.6	6.65-10.28	0.93-1.28	0.75-1.89	30-70	110-240
	20	20	20	20	20	20
Oysters (Maryland & Virginia)	88.3±0.2	5.77±0.24	0.65±0.02	1.06±0.08	36±4	121±5
	87.0-90.0	4.48-7.86	0.55-0.83	0.56-1.97	20-70	100-140
Crassostrea virginica	21	20	20	19	17	7
Scallops (Bay)	78.8±0.7	14.1±0.1	1.42±0.02	0.20±0.03	32±5	207±5
Pecten sp.	76.4-87.8	12.9-14.8	1.25-1.59	0.09-0.43	20-80	180-250
	20	19	20	20	16	17
Scallops (Calico)	77.8±0.4	16.9±0.1	1.79±0.01	0.21±0.02	32±2	215±5
Argopecten gibbus	76.8-83.6	15.9-18.5	1.71-1.89	0.11-0.31	20-60	160-270
	20	20	20	19	19	20
Scallops (Sea)	78.2±0.2	18.2±0.1	1.50±0.02	0.17±0.02	22±1	234±16
Placopecten magellanicus	77.2-79.7	17.1-19.0	1.38-1.84	0.02-0.32	20-30	150-320
	21	20	20	20	15	16

*Mean and standard error of the mean.
**Range.
***Number of analyses.

TABLE V-B-5: COMPOSITION OF THE EDIBLE PORTIONS OF RAW (FRESH OR FROZEN) CRUSTACEA, FINFISH, AND MOLLUSKS, I. PROTEIN, FAT, MOISTURE, ASH, CARBOHYDRATE, ENERGY, AND CHOLESTEROL

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol
	grams per 100 grams					cal/100g	mg/100g
Abalone	*14.9±0.2	0.5±0.1	76.9±2.9	1.8±0.6			
Haliotis kamtschatkana	**10.4-18.2	0.3-0.7	72.6-82.4	1.0-3.0	---	---	---
	***4	3	3	3			
Albacore	24.2±0.5	5.4±0.9	70.2±1.0	1.3±0.1	0.2	134±17	
Thunnus alalunga	19.1-27.6	0.7-18.2	62.3-78.6	1.2-2.4	---	107-185	---
	18	19	17	18	1	5	
Amberjacks	21.1±0.7	1.6±0.4	75.2±1.2	1.2		96	
Seriola spp.	20.1-22.5	0.8-3.1	73.4-77.5	1.1-1.3	---	---	---
	3	5	3	2		1	
Anchovies	20.2±0.7	2.4±0.8	76.0±1.1	1.8±0.1		93±5.3	
Engraulidae spp.	18.4-21.8	0.5-3.8	73.4-81.0	1.5-2.1	---	73-103	---
	4	4	4	4		3	
Anchovy, striped	17.4±0.2	2.8±0.2	76.6±0.3	3.3±0.1			
Anchoa hepsetus	16.2-18.9	1.6-4.6	74.2-78.1	2.6-4.1	---	---	---
	21	21	21	21			
Barracouta	22.0±0.1	4.8±1.2	71.0±0.9	1.6±0.2	0.7	132	
Thyrsites atun	21.9-22.1	2.6-6.7	69.5-72.6	1.3-1.8	---	---	---
	3	3	3	3	1	1	
Barracudas	19.8±0.2	3.2±0.4	75.8±0.4	1.7±0.1	1.1±0.3	94±3.1	
Sphyraenidae spp.	18.4-22.1	0.2-10.3	69.1-79.5	1.1-2.5	0.1-2.2	77-110	---
	39	43	40	40	6	9	
Basses	18.1±0.3	3.0±0.6	77.4±0.7	1.4±0.2		113±11.0	
Percichthyidae spp.	16.6-18.9	0.1-6.7	74.5-81.1	1.0-2.9	---	92-129	---
	11	9	11	11		3	
Basses	18.6±0.3	1.6±0.4	78.6±0.3	1.1±0.1			
Serranidae spp.	17.3-20.1	.1-3.0	77.3-79.6	0.9-1.2	---	---	---
	7	7	7	7			
Bluefishes	21.0±0.4	3.8±0.8	74.7±1.7	1.3±0.1			
Pomatomidae spp.	20.4-21.6	2.1-4.8	69.0-81.4	1.1-1.5	---	---	---
	3	3	6	4			
Bonita	24.7±1.6	4.5±2.0	71.3±1.9	1.5±0.1			
Sarda spp.	22.6-29.3	1.5-10.2	66.3-74.8	1.4-1.7	---	---	---
	4	4	4	4			
Bream	17.9±1.0	1.6±0.4	74.8±3.5	1.5±0.4		82.3±4.6	
Pagellus spp.	16.4-20.7	0.5-2.3	61.3-80.2	1.4-1.6	---	70-92	---
	4	5	5	5		4	
Bream, lg-eyed	18.4±0.6	1.0±0.4	78.2±0.6	1.2±0.2	1.6	90.5	
Monotaxes grandoculis	17.1-19.0	0.6-1.8	77.0-79.2	0.8-1.4	---	89-92	---
	3	3	3	3	1	2	
Burbot	18.0±0.7	0.8±0.2	80.3±0.2	1.3±0.3			
Lota lota	16.8-19.2	0.6-1.2	80.1-80.6	1.0-1.9	---	---	---
	3	3	3	3			
Butterfishes	17.7±0.4	7.2±1.9	74.3±1.7	1.4±0.4	1.3±0.6	95	
Stromateidae spp.	15.0-20.7	0.9-24.5	56.5-80.4	0.9-2.5	0.3-2.6	95-95	---
	13	13	13	13	4	2	
Carp	20.6	2.7	74.7	1.4			
Barbus spp.	16.0-25.2	2.3-3.1	70.3-79.1	1.2-1.5	---	---	---
	2	2	2	2			

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbo-hydrate	Energy	Choles-terol
	grams per 100 grams					cal/100g	mg/100g
Carp *Cirrhina mrigala*	18.9±0.2 18.1-19.6 10	0.9±0.5 0.2-4.0 8	78.0±0.4 75.0-79.8 10	1.4±2.1 1.0-1.6 8	1.4±0.2 0.6-2.0 7	86.7±0.9 84.0-90.0 7	---
Carp *Cyrpinus carpio*	18.0±0.2 17.4-19.3 9	6.2±1.2 3.3-14.8 9	75.6±1.1 66.2-79.8 14	1.1±0.03 1.0-1.2 7	---	---	---
Carp, Indian *Labeo* spp.	16.8±0.4 14.3-19.1 12	4.6±2.9 0.5-24.5 8	79.7±0.8 72.5-82.1 12	1.3±0.1 0.9-1.4 8	0.4±0.1 0.3-0.4 2	---	---
Catfishes, air-breathing *Clariidae* spp.	17.3±0.8 15.0-19.7 5	2.5±1.0 0.4-4.8 5	77.6±0.7 76.3-79.9 5	1.4±0.2 1.1-2.1 5	0.2 0.1-0.3 2	103±12.7 78-117 3	---
Catfishes, freshwater *Ictaluridae* spp.	17.6±0.8 15.4-22.8 10	3.2±1.8 0.3-11.0 10	77.8±1.2 68.0-82.6 14	1.1±0.1 0.9-1.7 10	---	---	---
Catfishes, sea *Ariidae* spp.	18.3±0.9 12.7-21.2 9	1.2±0.3 0.2-2.9 8	78.3±0.6 75.1-81.1 9	1.3±0.1 0.9-1.6 9	0.5±0.1 0.4-0.6 3	84.2±3.0 74-90 5	---
Chubs, sea *Kyphosidae* spp.	21.1 --- 1	4.2 2.0-6.3 2	76.0 75.9-76.0 2	1.3 1.1-1.4 2	---	102 --- 1	---
Chubs, Utah *Gila atraria*	15.5 --- 1	4.8 --- 1	79.3 --- 1	1.0 --- 1	---	---	---
Cisco, longjar, trout *Coregonus alpenae*	15.5±0.8 13.3-16.9 4	12.5±3.1 7.6-21.5 4	71.2±2.8 63.8-77.2 4	1.5±0.4 1.0-2.7 4	---	---	---
Clam Miscellaneous spp.	11.7±0.4 7.6-19.0 21	1.4±0.2 0.3-4.8 19	83.0±0.7 73.7-87.9 16	1.8±0.2 0.8-3.9 11	---	---	---
Clam, short neck *Venerupis semi decusata*	12.8±0.2 12.2-13.6 5	0.8±0.04 0.7-0.9 5	84.9 --- 1	---	---	---	---
Calm, soft shell *Mya arenaria*	11.2±0.06 9.7-15.6 10	2.0 1.4-2.5 2	84.8±1.0 78.5-87.8 8	1.7 --- 1	1.7 --- 1	89 --- 1	---
Cod, Atlantic *Gadus morhua*	17.9±0.4 16.5-20.7 9	0.3±0.1 0.1-0.8 8	81.1±0.4 78.2-82.6 10	1.1±0.3 1.0-1.2 7	---	---	---
Cods *Gadus* spp.	18.8±0.7 17.7-21.4 5	0.5±0.2 0.1-1.0 5	79.2±1.0 75.5-81.4 5	1.5±0.2 1.1-2.1 5	---	86.0±5.6 79.0-97.0 3	---
Congers, pike *Muraenesocidae* spp.	18.4±0.7 16.9-21.5 6	0.9±0.2 0.2-1.5 5	78.9±0.6 77.3-80.3 6	1.3±0.2 0.6-2.0 6	0.8 --- 1	85±4.0 80-93 3	---
Crab Miscellaneous spp.	15.8±1.4 7.2-22.4 10	3.1±1.3 0.1-12.5 9	76.1±1.8 61.0-84.7 12	2.5±0.5 1.4-6.2 9	---	---	---
Crab, blue *Callinectes sapidus*	16.1±0.5 11.9-19.2 18	1.0±0.1 0.4-1.5 18	81.2±0.6 77.4-86.7 17	1.6±0.1 1.3-1.8 15	1.25 0.5-2.0 2	81.5 77-86 2	84 70-98 2

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbo-hydrate	Energy	Choles-terol
	grams per 100 grams					cal/100g	mg/100g
Crab, Dungeness *Cancer magister*	17.2±0.7 14.3-23.4 12	1.4±0.1 0.7-2.2 14	80.5±0.3 78.5-82.3 13	1.4±0.1 1.2-1.9 11	---	85±4.6 77-97 4	57.5 52-63 2
Crab, deep sea *Neptunnia* spp.	16.5±0.5 12.8-18.8 12	0.5 --- 1	78.4±0.6 75.9-81.4 12	1.45 0.6-2.3 2	0.3 --- 1	---	---
Crab, King *Paralithodes camtschatica*	17.2±0.7 14.6-19.0 7	0.7±0.2 0.2-1.4 6	80.7±0.6 80.1-82.8 6	1.6±0.2 1.3-2.2 5	---	---	---
Crab, samaon *Scylla serrata*	14.9±0.4 11.8-20.1 22	2.9±1.1 0.7-4.0 3	80.3±0.5 75.1-83.9 22	1.8±0.1 1.5-1.9 4	0.6 --- 1	---	---
Crayfish Miscellaneous spp.	18.7±0.9 17.0-19.6 3	1.7 --- 1	76.3±0.2 72.4-80.1 3	1.1 --- 1	---	---	---
Croakers *Sciaenidae* spp.	19.0±1.4 14.1-29.1 9	1.9±0.4 0.4-4.9 10	78.5±1.1 72.0 9	1.3±0.1 0.9-1.8 9	---	103 --- 1	---
Dolphin *Coryphaena equisetis*	19.0±0.4 18.5-19.8 3	1.6±0.8 0.7-3.2 3	75.4 --- 2	1.5 --- 2	---	94.3±6.6 85-107 3	---
Dories *Zeidae* spp.	18.4 18.3-18.4 2	1.05 0.9-1.2 2	78.1±0.7 77.0-79.3 3	1.3±0.03 1.2-1.3 3	---	80.0 --- 1	---
Drum *Sciaenidae* spp.	19.2±0.3 18.1-20.1 6	1.5±0.2 0.9-1.9 4	76.9±1.1 69.7-80.2 8	1.6±0.2 0.9-2.4 8	---	91.0 --- 1	---
Drum, freshwater *Aplodinotus grunniens*	17.4±0.2 15.9-18.4 11	5.5±0.7 1.0-8.4 11	76.7±1.0 73.9-82.7 10	1.1±0.02 1.0-1.1 10	---	---	---
Eel, conger *Congridae* spp.	16.4 --- 2	4.5 --- 2	77.6±1.0 76.3-79.5 3	1.2±0.2 1.0-1.5 3	---	110.5 99-122 2	---
Eels, freshwater *Anguillidae* spp.	18.0 --- 2	17.3±2.6 12.7-21.5 3	65.0±1.8 62.2-70.1 4	1.3 --- 2	---	246 237-255 2	---
Eels, snake *Ophichthidae* spp.	17.7±0.4 15.3-20.2 18	0.9±0.2 0.1-3.1 18	78.8±0.5 74.0-81.1 17	1.3±0.1 0.2-2.6 18	0.6±0.2 0.3-2.4 10	81.4±3.3 73-104 11	
Flatheads *Percophididae* spp.	19.0±0.5 17.6-20.0 4	1.1±0.3 0.2-1.8 4	80.2±2.9 78.4-83.0 5	1.3±0.2 1.0-1.9 5	---	87±2.9 82-95 4	---
Flounder, winter *Pseudopleuronectes americanus*	17.4±2.3 16.0-19.9 6	0.8±0.5 0.2-3.0 6	79.5±0.9 75.4-81.0 6	1.3±0.0 1.2-1.3 5	---	---	---
Flounders *Bothidae* spp.	19.0±0.6 17.3-20.8 7	0.9±0.2 .1-2.5 11	78.1±0.7 76.0-80.1 7	1.7±0.2 1.3-2.3 4	0.6 0.4-0.8 2	84.3±5.4 78-95 3	---
Flounders *Pleuronectidae* spp.	17.3±0.3 14.0-20.3 22	1.0±0.2 0.1-2.9 21	80.8±0.4 76.8-84.1 20	1.3±0.1 1.1-2.3 15	1.3 --- 1	87.7±3.4 81-92 3	---

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbo-hydrate	Energy	Choles-terol
	grams per 100 grams					cal/100g	mg/100g
Flyingfish and halfbeaks *Exocoetidae* spp.	20.1±0.9 17.1-23.5 7	1.1±0.2 0.2-1.4 7	77.5±0.7 75.2-80.3 8	1.2±0.1 0.6-1.6 8	0.4 --- 1	92.3±3.2 83-97 4	---
Goatfish, dwarf *Upeneus parvus*	19.8±0.2 19.7-21.5 14	4.0±0.5 1.6-7.0 14	75.2±0.6 71.7-78.4 15	1.8±0.1 1.6-2.5 15	---	---	---
Goatfishes *Mullidae* spp.	20.1±0.7 16.9-22.9 9	2.0±0.5 0.4-4.7 9	76.3±0.6 74.5-78.1 6	1.7±0.5 0.6-4.0 6	---	106.3±5.0 99-120 4	---
Gobies *Gobiidae* spp.	17.4±0.6 15.4-20.5 11	1.1±0.3 0.1-2.7 11	79.3±0.5 76.5-81.8 11	1.8±0.2 1.0-2.9 11	0.3 --- 1	75±0.6 74-76 3	---
Goosefishes *Lophiidae* spp.	13.2±1.0 10.6-15.2 4	1.2±0.5 0.3-2.5 4	83.6±0.4 82.9-84.2 3	1.6±0.2 1.2-2.0 3	---	62.7±2.3 58-65 3	---
Groupers *Serranidae* spp.	19.2±0.3 16.4-20.8 12	0.8±0.2 0.2-2.3 13	78.6±0.3 76.0-79.8 13	1.3±0.1 0.9-1.8 13	1.0 --- 1	87.4±2.3 83.0-94.0 5	---
Grunts *Pomadasyidae*	19.2±0.4 17.7-21.1 9	0.9±0.3 0.2-2.7 9	77.9±0.5 75.6-79.8 9	1.8±0.3 1.1-3.5 9	2.2 --- 1	87.3±2.3 80-92 6	---
Haddock *Melanogrammus aeglefinus*	18.3±0.3 15.4-19.6 13	0.5±0.2 0.1-1.2 5	80.3±0.3 79.1-81.7 11	1.1±0.1 1.0-1.2 3	---	79 --- 1	66.3±13.0 45.0-90.0 3
Hakes *Merluccius* spp.	16.3±0.3 15.4-16.9 4	1.2±0.5 0.6-2.7 4	81.1±1.0 78.5-83.1 4	1.2±0.1 1.0-1.5 4	---	86 --- 1	---
Halibut, Atlantic *Hippoglossus hippoglossus*	17.7±1.3 12.6-20.1 5	2.4±0.9 0.7-5.2 5	78.1±0.7 76.5-82.9 9	1.1 --- 1	---	126 --- 1	60 --- 1
Halibut, Pacific *Hippoglossus Stenolepis*	21.1±0.1 20.3-22.0 12	1.1±0.2 0.6-3.6 13	77.9±0.1 77.3-78.7 16	1.4±0.0 1.2-1.4 12	---	---	---
Herring, Atlantic *Clupea harengus*	18.2±0.8 15.2-21.9 7	15.7±1.9 2.4-29.1 17	60.1±2.5 52.6-78.0 11	1.7 --- 1	---	---	---
Herring, fimbriated *Sardinella fimbriata*	20.0±0.4 18.3-21.8 7	2.0±0.5 0.4-3.6 6	76.1±0.8 71.3-78.1 8	2.0±0.2 1.3-3.4 8	1.7 0.6-2.7 2	102.3±8.9 88-128 4	---
Herring, lake, trout *Coregonus artedii*	18.8±0.9 15.6-20.8 6	3.3±1.04 1.5-7.2 6	77.6±1.1 62.6-81.3 18	1.4±0.2 1.0-2.8 8	---	---	---
Herring, Pacific *Clupea harengus pallasi*	14.6±1.7 9.4-16.5 4	11.1±1.6 8.0-12.8 3	71.5 69.0-73.9 2	3.8±0.9 2.5-3.3 7	---	---	---
Jack mackerel *Trachurus trachurus*	19.7 --- 1	6.8±4.3 1.5-15.3 3	76.7 --- 1	1.2 --- 1	---	---	---
Jacks *Caranx* spp.	19.9±0.4 16.6-22.0 14	1.2±0.5 0.1-6.1 12	76.5±0.5 71.5-79.8 16	1.5±0.1 1.0-2.7 15	0.6±0.4 0.2-1.4 3	96.6±45 84-135 10	---

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbo-hydrate	Energy	Choles-terol
	grams per 100 grams					cal/100g	mg/100g
Kingfishes *Menticirrhus* spp.	17.2±0.3 16.5-17.9 5	3.1±1.1 0.7-6.1 5	78.4±1.2 75.3-81.7 5	1.1±0.1 1.1-1.3 5	---	---	---
Leatherjacket *Scomeroides lysan*	19.9±0.3 19.3-20.7 4	1.3±0.4 0.1-1.8 4	77.1±0.4 76.4-77.7 4	1.6±0.1 1.3-1.8 4	0.3 --- 1	109 88-130 2	---
Lincod *Ophiodon elongatus*	17.5±0.4 16.7-18.1 3	0.7±0.2 0.5-1.0 3	80.2 79.2-81.1 2	1.2±0.0 1.2-1.2 3	---	99 81-117 2	---
Lizardfish *Saurida tumbil*	19.3±0.3 17.4-23.5 17	1.13±0.1 0.1-1.8 18	78.2±0.3 76.3-80.2 17	1.7±0.1 1.4-2.2 17	---	---	---
Lizardfish *Saurida undosquamis*	19.4±0.2 18.4-20.9 13	2.3±0.2 0.5-3.4 13	77.0±0.3 75.6-79.2 13	1.8±0.1 1.5-2.2 12	0.9 --- 1	88 ---	---
Lobster *Panulirus* spp.	19.6±0.8 16.2-21.6 7	1.3±0.2 0.6-1.9 6	76.0±1.1 71.5-81.2 10	2.4±0.6 1.2-3.4 4	0.8 --- 1	95 92-98 2	260 170-350 2
Mackerel *Scomber* spp.	22.0±0.3 13.5-25.3 44	5.3±0.7 0.3-18.1 42	71.7±0.6 61.4-77.7 45	1.5±0.04 1.1-2.4 43	0.3 --- 1	114±3.6 108-124 4	---
Mackerel *Scombermorus* spp.	18.9±0.5 15.9-22.4 16	3.7±1.4 0.2-14.4 13	74.9±1.4 63.0-82.1 15	1.3±0.1 0.9-1.6 15	2.8±0.1 2.6-3.0 3	103.4±17.3 80-172 5	---
Mackerel *Auxis* spp.	24.8 23.7-25.8 2	3.2±1.2 0.7-7.2 5	71.2 70.2-72.2 2	1.4 1.3-1.5 2	---	---	---
Mackerel, Atlantic *Scomber scomberus*	19.1±0.6 15.1-23.1 17	16.3±2.1 0.7-24.0 17	64.0±1.9 49.3-78.6 15	1.5±0.1 1.0-3.0 15	---	169±30.7 84-230 4	80 --- 1
Mackerel, Indian *Rastrelliger* spp.	19.1±0.7 16.6-21.4 9	2.0±0.4 0.5-4.1 14	76.4±0.8 73.3-79.3 9	1.5±0.1 1.1-2.2 9	2.1±0.2 1.8-2.5 3	97.7-3.8 92-105 3	---
Mackerel, Pacific *Pneumatophorus japonicus*	21.2 --- 1	4.6±2.5 1.6-9.5 3	72.3 --- 1	2.4 --- 1	---	---	---
Mojarras *Gerreidae* spp.	18.6±0.6 17.7-19.6 3	1.3 1.2-1.3 2	78.5±0.2 --- 3	1.6±0.3 --- 3	---	84 --- 1	---
Mullet *Mugil* spp.	19.2±0.7 12.3-22.6 14	3.3±0.5 0.4-5.9 11	75.3±1.1 69.3-86.0 15	1.4±0.1 0.9-2.1 13	2.2 1.9-2.4 2	128.4±13.4 103-124 5	---
Mullet, striped *Mugil cephalus*	19.4±0.4 17.9-21.8 11	5.5±1.3 0.2-14.8 12	73.7±1.4 64.5-80.2 11	1.3±0.1 1.0-1.8 10	---	143±13.7 102-219 8	---
Mullet, red *Mullus barbatus*	19.0±0.4 16.8-23.0 19	5.0±0.7 0.8-10.8 19	75.3±0.8 68.4-79.9 19	1.7±0.1 1.3-2.1 18	---	---	---
Needlefishes *Belonidae* spp.	23.2±1.8 20.6-26.6 3	1.1±0.5 0.3-2.1 3	74.9±2.3 70.4-78.0 3	1.6±0.1 1.4-1.8 3	---	84.5 78-91 2	---

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol
	grams per 100 grams					cal/100g	mg/100g
Ocean perch, Pacific *Sebastes alutus*	18.1±0.6 17.2-19.2 3	1.4±0.1 1.2-1.5 3	79.1±0.4 78.4-79.8 3	1.2±0.03 1.1-1.2 3	---	---	---
Oysters *Ostreidae* spp.	7.8±0.5 5.0-14.3 22	1.5±0.1 0.7-2.6 21	84.8±0.9 76.0-93.0 26	1.8±0.1 1.1-2.7 19	4.2±0.3 2.3-6.5 20	78.5±5.7 54-92 6	262±52.9 112-470 6
Oyster, blue point *Crassostrea virginica*	6.9±0.3 5.6-10.0 24	1.5±0.1 0.7-2.4 24	85.7±0.5 77.4-90.2 40	1.5±0.1 0.7-2.9 23	3.3±0.2 1.9-4.7 18	---	47.5 37-58 2
Parrotfishes *Scaridae* spp.	19.7±0.7 18.9-21.0 3	0.9±0.5 0.4-2.0 3	78.7±1.4 75.8-80.2 3	1.3±0.1 1.1-1.5 3	---	105 --- 1	---
Perch, yellow *Perca flavescens*	19.0±0.3 17.3-19.9 9	0.9±0.1 0.5-1.2 8	79.1±0.3 78.3-80.2 6	1.4±0.3 0.6-3.3 8	---	---	---
Perches *Serranidae* spp.	18.0 --- 1	1.0±0.4 0.3-1.5 3	81.1±0.5 80.4-82.0 3	1.2 1.1-1.2 2	---	83 --- 1	---
Pikes *Esocidae* spp.	19.0 18.2-19.7 2	1.2 1.2-1.2 2	77.9±1.8 72.5-80.2 4	1.2 1.1-1.3 2	---	---	---
Pilchards *Sardinops* spp.	16.7±0.6 14.7-19.4 7	2.0±0.7 0.3-5.2 7	76.7±0.6 74.5-78.9 7	3.7±0.6 1.1-4.9 7	---	87.3±10.3 70-117 4	---
Pilchard *Sardina caerulea*	19.2±0.2 16.9-21.4 30	8.0±1.1 0.3-21.4 32	71.4±1.1 59.7-79.7 30	1.8±0.3 1.3-2.7 4	---	---	---
Pollack, coalfish *Pollachius virens*	18.6±0.3 17.4-19.3 7	0.5±0.1 0.2-1.0 7	79.2±0.7 77.4-81.6 6	1.6±0.1 1.3-2.0 6	---	---	---
Pollack, walleye *Theragra chalcogramma*	17.4 16.8-18.0 2	0.9 0.7-1.0 2	82.5 --- 1	1.1 --- 1	---	---	---
Pomfrets *Bramidae* spp.	18.9±0.6 16.2-21.6 10	1.1±0.3 0.6-1.4 3	76.5±1.1 70.6-80.3 10	1.3±0.2 0.4-2.2 7	2.8 1.3-2.3 2	93.3±4.1 84-101 4	---
Pompano *Trachinotus* spp.	19.3±0.4 17.6-21.0 8	1.4±0.4 0.2-4.0 8	77.3±0.6 75.3-80.4 8	1.2±0.1 0.4-1.5 8	2.8 --- 1	86.2±3.4 83-99 5	---
Porgies *Dentex* spp.	19.9±0.5 18.7-21.4 5	1.8±0.5 1.0-3.5 5	77.4±0.7 76.4-80.0 5	1.6±0.2 1.3-2.1 5	---	94.7±5.2 86-104 3	---
Porgies *Sparus* spp.	20.8±0.4 19.0-22.8 8	1.8±0.5 0.2-4.9 10	75.3±0.5 73.6-77.4 8	1.5±0.2 1.3-2.5 8	1.1 0.7-1.5 2	100.7±3.5 90-115 6	
Porgies *Pagrus* spp.	20.3±0.2 19.9-20.5 3	1.2±0.5 0.6-2.2 3	77.1±0.2 76.9-77.5 3	1.5±0.2 --- 3	---	102 --- 1	---
Porgy *Box boops*	19.0±0.8 17.3-20.9 4	6.3±1.3 4.5-10.1 4	73.5±1.5 69.3-76.5 4	1.9±0.2 1.4-2.4 4	---	128.8±13.8 113-170 4	---

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbo-hydrate	Energy	Choles-terol
	grams per 100 grams					cal/100g	mg/100g
Prawns	16.8±1.1	1.2±0.2	75.3±1.0	2.7±0.3			
Miscellaneous spp.	8.9-23.2	0.3-3.1	67.5-80.6	1.6-5.2	---	---	---
	19	17	20	14			
Puffer	23.2	0.7	74.2	1.1			
Sphoeroides spp.	---	---	---	1.0-1.2	---	---	---
	1	1	1	2			
Redfish	18.0±0.1	1.3±0.2	79.4±0.2	1.1±0.0			
Sebastes marinus	17.9-18.1	0.6-2.2	78.8-79.6	1.1-1.1	---	---	---
	7	7	6	6			
Rockfishes	18.8±0.3	1.2±0.2	78.3±0.5	1.2±0.02			
Sebastes spp.	17.2-20.8	0.2-2.4	75.1-80.0	1.1-1.3	---	---	---
	13	14	12	11			
Sablefish	13.3	14.0	71.5	1.0			
Anoplopoma fimbria	12.9-13.6	12.8-15.2	---	---	---	---	---
	2	2	1	1			
Salmon, Chinook	16.2±0.4	11.5±2.4	67.6±2.2	0.9±0.02			
Oncorhynchus tshawytscha	13.4-17.6	2.2-19.0	61.3-79.9	0.9-1.0	---	---	---
	10	8	10	10			
Salmon, chum	20.7±0.7	4.3±0.6	73.8±1.4	1.5±0.1			
Oncorhynchus keta	18.4-24.5	1.3-4.8	68.9-78.3	1.2-1.7	---	---	---
	9	11	8	8			
Salmon, coho	21.5±0.1	5.7±0.5	72.7±0.5	1.2±0.01			
Oncorhynchus kisutch	20.5-22.0	3.1-9.0	70.3-75.3	1.1-1.3	---	---	---
	14	14	13	13			
Salmon, pink	19.4±0.2	5.3±0.4	74.0±0.5	1.2±0.02			65
Oncorhynchus gorbuscha	17.2-20.6	2.0-9.4	69.0-78.3	1.1-1.4	---	---	---
	22	36	33	21			1
Salmon, sockeye	20.9±0.5	7.5±1.2	72.8±1.4	1.2±0.02			
Oncorhynchus nerka	17.9-22.7	1.6-19.2	65.6-80.3	1.1-1.3	---	---	---
	13	16	14	12			
Sandlanches	17.9	1.5	78.0	2.8		87.0	
Ammodytes lancedatus	---	---	---	---	---	---	---
	1	1	1	1		1	
Sardine	19.0	3.7	77.1	2.6			
Sardinella eba	---	---	---	---	---	---	---
	1	1	1	1			
Sardine, gilt	20.5±0.2	3.8±0.3	74.8±0.3	2.1±0.1			
Sardinella aurita	17.3-22.3	0.4-20.0	65.9-79.9	1.4-2.9	---	---	---
	49	125	50	49			
Sardine, Indian	19.3±0.7	2.9±0.6	75.7±0.1	1.5±0.1	0.7	103±6.0	
Sardinella longiceps	17.7-21.0	1.9-4.6	75.3-76.0	1.3-1.6	0.1-1.3	91-110	---
	4	4	4	4	2	3	
Scad	21.8±1.5	2.4±0.7	75.4	1.5	1.2	109	
Decapterus spp.	19.2-24.4	1.0-4.9	74.2-76.6	1.1-1.8	---	101-117	---
	3	5	2	2	1	2	
Scallop	17.2±0.7	0.7±0.2	79.2±0.8	1.7±0.1			
Pectinidae spp.	15.2-20.1	0.3-1.6	74.6-85.6	1.3-1.8	---	---	---
	7	7	11	6			
Scallop, Atlantic Bay	15.4±0.2	0.5±0.03	80.7±0.4	1.4±0.04	1.7±0.2		105.7±35.2
Pecten irradians	13.4-17.0	0.3-0.9	74.6-83.7	1.1-1.7	1.4-1.9	---	60-175
	24	24	24	24	3		

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbo-hydrate	Energy	Choles-terol
	grams per 100 grams					cal/100g	mg/100g
Scallop, calico	15.9±0.2	0.6±0.06	79.8±0.4	1.5±0.03			
Aequipecten gibbus	15.6-16.4	0.5-0.7	78.8-80.4	1.4-1.5	---	---	---
	4	4	4	4			
Scup	18.8±0.1	3.7±0.8	75.5±0.6	1.2±0.1			
Stenotomus chrysops	18.4-19.1	1.2-5.9	73.6-77.0	1.1-1.4	---	---	---
	5	5	5	5			
Shad	18.5±0.5	8.3±1.7	71.4±1.4	1.5±0.1			
Alosa sapidissima	15.7-20.0	1.7-15.2	64.6-77.0	1.2-1.9	---	---	---
	9	9	9	9			
Shad	17.4±0.7	12.0±3.6	70.2±2.6	2.1±0.4		87	
Clupeidae spp.	15.1-21.5	1.2-23.1	58.0-78.3	1.2-4.2	---	---	---
	8	6	8	8		1	
Sharks	22.7±0.8	0.5±0.2	76.3±0.5	1.3±0.1		101±4.3	
Mixed spp.	14.9-27.1	0.1-2.9	72.0-76.9	1.0-2.0	---	---	---
	18	14	17	17		4	
Shrimp	20.5±0.71	1.1±0.2	76.2±0.7	2.6±0.5	2.2	88.3±9.7	159.5±13.8
Miscellaneous spp.	16.2-22.7	0.1-3.2	69.6-84.8	1.3-6.8	---	69-99	138-200
	16	19	26	14	2	3	4
Skates	20.3	0.2	78.0±0.9	1.3		80	
Rajidae spp.	19.0-21.5	---	76.4-79.6	1.1-1.4	---	---	---
	2	1	3	2		1	
Skipjack	25.5±0.4	3.4±0.6	70.0±0.4	1.5±0.1			
Euthynnus pelamis	23.8-26.6	0.3-7.4	68.6-71.1	1.3-1.7	---	---	---
	8	14	6	7			
Smelts	16.6±0.6	3.9±0.7	79.0±0.4	1.5±0.2			
Osmeridae spp.	14.3-18.8	2.3-6.7	76.8-80.2	1.1-2.3	---	---	---
	9	9	8	6			
Snappers	19.2±0.4	2.0±0.5	77.9±0.5	1.3±0.1	0.7±0.2	99.5±5.2	
Lutjanidae spp.	16.7-21.9	0.4-7.4	72.7-81.9	1.0-1.7	.2-1.3	82-146	---
	16	16	19	15	4	12	
Snooks	18.5±1.1	0.9±0.2	78.3±0.7	1.2±0.1	0.6	82.5	
Centropomidae spp.	13.7-20.6	0.3-1.9	77.0-82.0	1.0-1.5	0.2-0.6	79-86	---
	6	6	8	8	2	2	
Soles	18.0±0.4	1.0±0.2	81.1±0.3	1.3±0.1			
Limanda spp.	17.0-19.2	0.1-1.3	80.0-82.7	1.1-1.5	---	---	---
	6	6	8	4			
Sole	18.7±1.3	1.07±0.5	78.4±1.2	1,7±0.2		82.5	
Soleidae	16.6-21.2	0.2-1.7	75.0-80.1	1.3-2.1	---	80-85	---
	3	3	4	4		2	
Sole, Dover	15.0±0.3	0.8±0.1	83.7±0.3	1.1±0.0			
Microstomus pacificus	13.9-16.6	0.6-1.2	82.6-84.4	1.1-1.1	---	---	---
	7	6	6	4			
Sole, English	17.1±0.4	1.4±0.1	81.2±0.2	1.2±0.0			
Parophys ventulus	16.4-18.5	1.2-1.8	80.7-81.8	1.2-1.3	---	---	---
	5	5	4	5			
Sole, Petrole	17.4±0.8	2.4±0.9	78.5±1.0	1.8±0.5		85.0	
Eopsetta jordani	14.8-19.4	0.9-6.7	74.8-81.0	1.2-3.8	---	---	---
	6	6	5	5		1	
Spot	17.9	3.1	77.5	1.1			
Leiostomus xanthurus	---	---	---	---	---	---	---
	1	1	1	1			

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbo-hydrate	Energy	Choles-terol
	grams per 100 grams					cal/100g	mg/100g
Sprat	16.9	6.7	69.2±1.2	1.9±0.1		176	
Clupea sprattus	16.7-17.1	1.8-11.6	66.8-71.0	1.8-2.0	---	---	---
	2	2	3	3		1	
Squawfish, northern	17.0±0.4	2.5±0.2	79.3±0.2	1.1±0.02			
Ptychocheilus oregonensis	15.6-18.0	1.8-3.1	78.8-80.1	1.0-1.1	---	---	---
	7	7	7	7			
Squid	15.3±1.1	1.0±0.2	79.3±1.6	1.8±0.3	3.0	89	
Loliginidae spp.	11.9-18.4	0.5-1.4	74.2-84.0	1.0-3.1	---	80-98	---
	6	6	6	7	1	2	
Surgeonfish	18.7±0.5	1.3±0.5	80.3±1.9	1.0±0.2	1.3	92.2±6.9	
Acipenseridae spp.	17.4-20.9	0.4-3.8	74.4-89.0	0.3-1.4	1.3-1.3	81-119	---
	6	6	6	5	2	5	
Swordfish	19.5±0.4	4.1±0.7	76.2±0.4	1.3±0.1	0.7	100	
Xiphias gladius	18.6-20.8	2.0-6.4	74.7-77.5	1.0-1.9	---	87-113	---
	6	6	6	6	1	2	
Trouts	16.1±1.1	11.0±1.1	71.3±1.8	1.3±0.2			
Salmonidae spp.	12.4-19.0	8.7-14.0	64.0-76.3	1.0-2.0	---	---	---
	5	5	6	5			
Trout, brook	17.5	4.5	74.5±1.2	2.7			
Salvelinus fontinalis	13.7-21.2	3.4-5.5	71.5-77.2	2.0-3.3	---	---	---
	2	2	4	2			
Trout, Dolly Varden	19.9	6.5	73.1	1.2			
Salvelinus malma	---	---	---	---	---	---	---
	1	1	1	1			
Trout, Lake	16.4±0.9	14.9±2.7	69.3±2.1	1.2±0.3			
Salvelinus namaycush	11.3-20.0	9.1-36.0	52.5-79.0	0.5-3.3	---	---	---
	9	10	11	8			
Trout, rainbow	22.0	11.7	72.0	1.3			
Salmo gairdneri	---	---	66.3-77.7	---	---	---	---
	1	1	2	1			
Tuna, big eye	22.5	1.3±0.3	73.1	1.3		98	
Thunnus obesus	---	0.6-2.0	---	---	---	---	---
	1	4	1	1		1	
Tuna, bluefin	24.7±0.3	3.9±0.6	70.4±0.4	1.3±0.02		122±3.2	
Thunnus thynnus	23.3-27.5	1.2-8.0	67.7-72.6	1.2-1.4	---	114-129	---
	13	13	13	12		5	
Tuna, yellowfin	24.3±0.2	2.2±0.5	73.2±0.5	1.5±0.03			
Thunnus albacares	22.9-25.8	0.1-9.5	67.3-77.1	1.3-1.9	---	---	---
	26	25	27	25			
Tunny. little	22.8±0.1	5.7±0.8	69.8±0.7	1.6±0.02			
Euthynnus alletteratus	22.0-25.4	0.7-20.2	59.0-74.4	1.2-2.1	---	---	---
	48	48	47	48			
Turbot	16.4	2.9	78.3	1.0		94	
Rhombus maximus	---	---	---	---	---	74-114	----
	2	2	2	2		2	

(Table V-B-5 Continued)

	Protein	Fat	Moisture	Ash	Carbohydrate	Energy	Cholesterol
	grams per 100 grams					cal/100g	mg/100g
Walleye	19.3±0.2	1.5±0.3	79.3±0.6	1.2±0.03			
Stizostedion vitreum	18.8-19.8	0.8-1.9	78.2-80.0	1.1-1.2	---	---	---
	4	4	3	3			
Weakfish	18.7±0.6	3.2±0.4	76.6±0.7	1.19±0.03			
Cynoscion regalis	15.7-20.0	1.4-4.3	74.6-79.6	1.1-1.3	---	---	---
	7	7	7	7			
Whitefish, lake, trout	18.0±0.3	7.6±1.2	73.4±1.3	1.3±0.1			
Coregonus clupeaformus	15.1-19.8	1.7-18.5	62.6-79.0	1.0-3.1	---	---	---
	16	17	14	15			
Whiting	16.1±0.3	1.2±0.3	80.7±0.5	1.2±0.02		87.7±11.8	75
Merluccius bilinearis	15.2-16.7	0.2-2.0	79.3-82.4	1.1-1.2	---	73-111	---
	6	6	5	5		3	1

*Standard error of the mean.

**Range.

***This number of averager used to compute the overall average.

TABLE V-B-6: COMPOSITION OF THE EDIBLE PORTION OF RAW (FRESH OR FROZEN) CRUSTACEANS, FINFISH, AND MOLLUSKS, II. SODIUM, POTASSIUM, CALCIUM, PHOSPHORUS, CHLORINE, AND MAGNESIUM

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Abalone Haliotidae spp.	---	---	*27±6 **21-34 ***2	---	---	112±62 50-175 2
Amberjacks and Yellowtails *Seriola* spp.	76±12 52-90 3	438±158 280-597 2	22±6 6-35 5	162±40 102-253 3	20 --- 1	35±2 30-40 3
Anchovies Engraulidae spp.	115±23 70-147 3	356±51 267-511 5	194±46 20-480 9	239±18 188-349 8	138±55 30-214 3	41±12 29-54 2
Barracudas Sphryaenidae spp.	89±43 46-132 2	252±48 155-307 3	40±7 22-70 8	328±60 156-598 8	230 --- 1	31±4 27-35 2
Basses, sea Serranidae spp.	71±8 30-112 11	332±37 138-580 13	48±7 7-140 17	205±12 150-375 20	105±15 90-135 3	24±6 10-40 4
Basses, temperate Percichthyidae spp.	---	---	71±61 10-132 2	---	---	---
Brills Bothidae spp.	---	---	30±0 30-30 2	204±0 204-204 2	---	---
Butterfishes Stromateidae spp.	94±7 81-106 3	346±52 203-434 4	96±39 17-314 8	300±43 159-506 8	---	---
Butterflyfishes Chaetodontidae spp.	104±3 101-108 2	263±47 216-310 2	37±11 12-57 4	140±8 116-153 4	120 --- 1	---
Caesios Caesionidae spp. (in Lutjanidae)	59 --- 1	391±127 264-519 2	35±1 34-36 4	274±97 165-565 4	---	---
Carps Cyprinidae spp.	59±6 43-105 11	295±18 174-435 17	52±6 12-182 45	318±16 165-605 54	37±10 30-45 4	---
Catfish, air-breathing Clariidae spp.	59±2 55-63 2	309±86 147-440 3	35±6 18-51 5	231±46 116-375 5	130 --- 1	33 --- 1
Catfishes, sea Ariidae spp.	79±24 55-103 2	322±109 109-468 3	71±26 14-98 9	208±27 148-440 10	110 --- 1	34 --- 1
Cavefishes Amblyopsidae spp.	---	---	550 --- 1	350 --- 1	---	---
Characins Characidae spp.	---	---	173 --- 1	266 --- 1	---	---
Cichlids Cichlidae spp.	52 --- 1	454 --- 1	68±23 37-112 3	173±90 39-344 3	---	---

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Clams, mactra Mactridae spp.	---	---	42 --- 1	325 --- 1	---	---
Clams, razor Solenidae spp.		143 1	60 1	204±6 198-210 2	---	---
Clams, tellin Tellinidae spp.	262 --- 1	164 --- 1	121 --- 1	83 --- 1	---	---
Clams (species unknown)	190±10 180-200 2	137±56 35-228 3	99±9 59-144 14	156±19 90-350 14	---	43±11 20-70 4
Cockles Cardiidae spp.	200 --- 1	197 --- 1	167±51 116-217 2	93±15 78-122 3	---	---
Cods Gadidae spp.	82±1 60-180 10	364±17 270-465 11	16±2 9-20 7	212±31 9-240 8	228±173 55-400 2	23±3 20-25 2
Crabs, blue *Callinectes sapidus*	---	188 --- 1	94±11 71-133 5	152±30 38-205 5	---	30±5 12-38 5
Crabs, deep sea *Neptunnis* spp.	---	134 --- 1	174±10 20-202 3	---	---	---
Crabs, Johan *Cancer borealis*	276 --- 1	279 --- 1	96 --- 1	12 --- 1	---	45 --- 1
Crabs, king *Paralithodes camtschatica*	---	55 --- 1	160 --- 1	---	---	---
Crabs, Samoan *Scylla serrata*	---	---	118±45 53-290 5	209±65 130-402 4	---	---
Crabs, Tanner *Chionoecetes tanneri*	120 --- 1	520 --- 1	140 --- 1	220 --- 1	---	130 --- 1
Crabs, Miscellaneous spp.	262±78 95-453 4	233±63 111-322 3	94±22 29-120 4	233±40 171-350 4	117 --- 1	48 --- 1
Crayfish Miscellaneous spp.	121±61 60-182 2	302±35 239-500 7	39±5 16-58 8	239±36 101-560 11	280 --- 1	60±20 40-80 2
Croaker Sciaenidae spp.	109±27 70-160 3	259±45 180-336 3	42±8 18-89 8	232±43 125-444 8	178±68 110-246 2	30 --- 1
Cusk *Brosme brosme*	---	---	20 --- 1	220 --- 1	---	---

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Cusk eels and brotulas Ophidiidae spp.	---	---	66 --- 1	345±200 145-545 2	110 --- 1	---
Cutlassfishes Trichiuridae spp.	94 --- 1	330 --- 1	75±47 13-214 4	301±90 160-542 4	100 --- 1	25 --- 1
Cuttlefish Misscellaneous spp.	---	239±35 204-273 2	27 --- 1	143 --- 1	---	---
Dace Cyprinidae spp.	---	270 --- 1	---	---	---	---
Dagol *Chorinemus toloo*	---	---	16 --- 1	424±26 398-449 2	750 --- 1	---
Damselfishes Pomacentridae spp.	---	---	---	728 --- 1	140 --- 1	---
Dolphins Coryphaenidae spp.	170±72 98-242 2	370 --- 1	15 --- 1	143 --- 1	---	---
Dories Zeidae spp.	60 --- 1	241±90 151-330 2	40 --- 1	181±51 130-231 2	70 --- 1	20 --- 1
Drepanes Drepanidae spp.	88 --- 1	373 --- 1	57±18 30-90 3	183±27 149-235 3	---	---
Drums Sciaenidae spp.	67±5 51-84 7	273±8 226-301 8	37±12 16-57 3	113±88 25-200 2	---	24 --- 1
Eels, conger Congridae spp.	50 --- 1	241±41 200-282 2	71±31 20-50 4	270±40 180-390 5	100 --- 1	20 --- 1
Eels, freshwater Anguillidae spp.	79±3 76-81 2	362±118 214-712 4	62±25 15-188 4	293±52 196-501 5	64±7 40-80 5	22±4 16-30 3
Eels, moray Muraenidae spp.	25 --- 1	165 --- 1	41±22 19-63 2	251±141 83-532 3	57±33 24-90 2	15 --- 1
Eels, pike conger Muraenesocidae spp.	88 --- 1	490 --- 1	70±43 27-112 2	243±38 205-280 2	---	---
Eels, snake Ophichthidae spp.	62±24 38-86 2	358±44 314-401 2	43±8 14-140 20	274±27 95-509 21	95 --- 1	34 --- 1
Eels, spiny Notacanthidae spp.	50 --- 1	270 --- 1	34±10 22-55 3	248±74 174-322 2	223 --- 1	27 --- 1
Eels, swamp Flutidae spp.	116 --- 1	172 --- 1	40±10 30-50 2	126±33 93-158 2	---	---

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Featherbacks *Notopterus* spp.	40±6 34-45 2	190±71 119-260 2	73±18 40-180 7	317±39 161-450 8	106 --- 1	32 --- 1
Flatheads Percophididae spp.	66±26 40-91 2	291±101 190-392 2	44±13 18-79 4	204±28 174-260 3	---	19±9 10-27 2
Flounders, left eye Bothidae spp.	100±32 54-160 3	220 --- 1	63 --- 1	313±66 185-401 3	235±5 230-240 2	44 --- 1
Flounders, right eye Pleuronectidae spp.	61±7 35-99 12	316±22 157-394 11	27±3 17-36 6	182±29 116-250 4	---	24±5 10-31 4
Flyingfishes and halfbacks Exocoetidae spp.	85±14 70-112 3	407±81 250-516 3	94±37 30-229 5	260±72 140-614 6	90 --- 1	20 --- 1
Gillrakers Chirocentridae spp.	---	---	22 1	1,150 1	---	---
Goatfishes Mullidae spp.	59±8 40-74 4	316±5 311-320 2	72±17 23-97 4	246±33 170-340 6	143±3 140-150 3	30 --- 1
Gobies Gobiidae spp.	92±30 50-150 3	294±58 250-360 3	92±47 15-370 7	324±47 151-554 9	178±72 106-250 2	28 --- 1
Goosefishes Lophiidae spp.	---	297 --- 1	13±6 7-19 2	334±132 180-597 3	370 --- 1	---
Greenlings Hexagrammidae spp.	58±2 52-62 8	411±17 352-478 7	34±12 12-55 3	173±8 165-180 2	---	18 --- 1
Grunts Pomadasyidae spp.	71±1 70-72 2	230±30 200-260 2	55±27 9-268 9	194±21 110-285 8	500 --- 1	10 --- 1
Guitarfishes Rhinobatidae spp.	---	---	11±2 9-12 2	257 --- 1	---	24 --- 1
Gurnards, flying Dactylopteridae spp.	80 --- 1	300±14 260-320 4	65±20 22-104 4	179±27 130-222 3	---	21±1 20-22 2
Haddock *Melanogrammus aeglefinnus*	57±2 49-67 8	342±26 299-434 5	19±3 10-30 5	208±46 164-318 9	---	24 --- 1
Hagfishes Myxinidae spp.	136 --- 1	114 --- 1	4 --- 1	160 --- 1	141 --- 1	26 --- 1
Halibut Pleuronectidae spp.	64±3 36-112 46	398±8 318-475 34	23±8 13-30 4	216±14 192-253 4	88 --- 1	23 --- 1
Herrings Clupeidae spp.	103±15 49-183 10	348±47 25-512 10	142±35 21-460 17	324±21 134-742 42	173±42 108-291 4	38±8 30-46 2

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Jacks Carangidae spp.	68±8 54-89 4	431±44 340-550 4	45±8 16-93 11	237±37 150-565 10	---	34±4 30-37 2
Kingfishes *Menticirrhus* spp.	85±2 83-87 2	250 --- 1	---	---	---	---
Lampreys Petromyzontidae spp.	---	183 --- 1	10 --- 1	---	---	---
Lings *Molva* spp.	---	---	20 --- 1	200 --- 1	---	---
Lizardfishes Synodontidae spp.	70 --- 1	390±124 266-513 2	30±9 13-49 4	291±56 201-445 4	110 --- 1	29 --- 1
Loaches *Misgurnus anguillicaudatus*	---	496 --- 1	28 --- 1	402 --- 1	---	---
Longaray Ambassidae spp.	---	---	67 --- 1	150 --- 1	---	---
Lumpfishes and snailfishes Cyclopteridae spp.	69 --- 1	485 --- 1	56 --- 1	203 --- 1	33 --- 1	---
Mackerels Scombridae spp.	90±14 30-252 15	320±27 136-471 16	58±11 5-343 35	267±25 148-778 33	105±39 35-170 3	30±3 25-40 4
Minnows Cyprinidae spp.	---	---	140 --- 1	180 --- 1	---	---
Mojarras Gerreidae spp.	107 --- 1	404 --- 1	65±34 6-122 3	231±40 191-312 3	---	---
Mullet Mugilidae spp.	73±6 52-100 7	303±11 259-356 7	40±8 11-99 16	258±21 140-436 19	131±21 120-152 2	29±2 25-33 5
Mussels Mytilidae spp	91±30 11-140 4	327±107 121-480 3	105±30 71-164 3	145±15 102-170 4	---	---
Needlefishes Belonidae spp.	79 --- 1	397±1 396-397 2	72±26 21-98 3	251±50 121-362 4	140 --- 1	---
Nemipterids Nemipteridae spp.	88 --- 1	500 --- 1	57±27 15-135 4	198±12 173-210 3	---	28 --- 1
Octopuses Mixed spp.	363 --- 1	232 --- 1	28±8 12-39 3	109±25 66-151 3	---	---
Oysters Ostreidae spp.	160±78 73-618 4	248±111 90-570 4	98±16 39-210 14	153±14 76-265 14	42 --- 1	32±7 12-230 6
Parrotfishes Scaridae spp.	---	---	54±18 36-90 3	167±23 143-213 3	---	---

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Perches Percidae spp.	63±3 50-80 3	264±13 210-324 12	30±0 30-30 2	168±29 110-230 4	---	20±0 20-20 2
Perches, climbing Anabantidae spp.	43±7 35-64 4	323±50 195-438 4	68±22 13-131 5	228±38 159-390 7	101±5 96-106 2	34±2 32-35 2
Periwinkles Littorinidae spp.	---	102 --- 1	---	---	---	---
Pickerels Esocidae spp.	---	---	---	---	606 --- 1	---
Pikes Esocidae spp.	52 --- 1	329±50 174-590 7	---	---	227 --- 1	175±27 148-202 2
Plaice Pleuronectidae spp.	91±8 83-98 2	312±18 277-333 3	20 --- 1	220 --- 1	---	25 --- 1
Promfrets Bramidae spp.	---	517 --- 1	132±109 23-240 2	---	223±83 140-305 2	---
Porgies Sparidae spp.	77±6 40-110 12	291±29 156-488 13	44±6 15-123 20	291±25 117-580 27	119±13 90-190 8	27±3 20-31 3
Puffers Tetraodontidae spp.	---	347 --- 1	18 --- 1	138 --- 1	---	---
Rays, eagle Myliobatidae spp.	---	---	---	179 --- 1	275 --- 1	---
Rays, electric Torpedinidae spp.	---	---	---	---	671 --- 1	---
Rays, stringray Dasyatidae spp.	156±23 133-179 2	294±58 236-352 2	19±3 9-25 7	129±11 99-170 7	---	38 38 1
Roaches Cyprinidae spp	---	270 --- 1	---	---	---	---
Sablefishes Anoplopomatidae spp.	56 --- 1	358 --- 1	77 --- 1	187 --- 1	---	---
Salmon, Australian Arripidae spp.	57±6 50-60 3	240±6 230-250 3	37±3 30-40 3	183±29 150-240 3	---	27±3 20-30 3
Sanddab Citharichthys spp.	397 --- 1	220 --- 1	25 --- 1	110 --- 1	---	44 --- 1
Sandfishes Trichodontidae spp.	---	---	61 --- 1	184 --- 1	---	---

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Sandlances		377				
Ammodytidae spp.	---	---	---	---	---	---
		1				
Sardines	90±6	218±73	134±19	350±28	138±7	
Clupeidae spp.	60-128	25-420	28-380	39-580	115-164	---
	10	5	21	27	6	
Sauries	60		22±0	190±0		50
Scomberesocidae spp.	---	---	22-22	190-190	---	---
	1		2	2		1
Sawfishes			54	238		
Pristidae spp.	---	---	---	---	---	---
			1	1		
Scad and mackerel	71±7	487±127	46±8	279±63	86±29	24±8
Carangidae spp.	53-94	360-614	12-71	115-680	28-120	20-37
	5	2	9	10	3	3
Scallops	182±19	278±58	78±38	270±38		30±10
Pectinidae spp.	163-200	162-340	40-115	210-340	---	20-40
	2	3	2	3		2
Scorpionfishes	65±2	366±12	18±3	229±64	75±5	
Scorpaenidae spp.	45-94	269-432	15-20	60-327	70-80	---
	32	19	2	4	2	
Sculpins	55	332				
Cottidae spp.	---	---	---	---	---	---
	1	1				
Sea chubs	50	268±42	38±2	335±79	240	20
Kyphosidae spp.	---	226-310	36-40	227-488	---	---
	1	2	2	3	1	1
Sea Cucumbers				67	14	
Mixed species	---	---	---	---	---	---
				1	1	
Searobins					296	
Triglidae spp.	---	---	---	---	---	---
					1	
Seatrout	59±0	305±12	40	120		
Sciaenidae spp.	59-60	280-317	---	---	---	---
	3	3	1	1		
Shad	69±15	274±56	108±16	203±28	216±40	41
Clupeidae spp.	54-98	162-330	22-127	39-323	140-276	---
	3	3	6	11	3	1
Sharks, dogfish	100	223±49	13±3	253±27		20
Squalidae spp.	---	174-272	7-16	176-300	---	---
	1	2	3	4		1
Sharks, hammerhead			20±5	163±45		20
Sphyrnidae spp.	---	---	15-25	118-208	---	---
			2	2		1
Sharks, mackerel			13	161±54	150	
Lamnidae spp.	---	---	---	107-214	---	---
			1	2	1	
Sharks, requiem	70	290	34±8	204±58	150	27±17
Carcharhinidae spp.	---	---	5-59	150-309	---	10-44
	1	1	7	9	1	2

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Sharks, sand tiger **Odontaspididae spp.**	79 --- 1	549 --- 1	68±48 9-164 3	211±26 141-288 5	140 --- 1	---
Sharks, thresher **Alopiidae spp.**	---	---	---	349 --- 1	120 --- 1	---
Sheathfishes **Siluridae spp.**	---	---	49 --- 1	152 --- 1	---	---
Shrimps and Prawns **Mixed species**	132±22 45-220 7	248±40 118-410 8	142±18 16-550 45	239±21 127-912 44	---	54±11 23-111 7
Siganids **Seganoidae spp.**	76 --- 1	450 --- 1	41±0 41-41 2	122±0 122-122 2	---	---
Silversides **Atherinidae spp.**	---	---	---	105 --- 1	---	---
Skates **Rajidae spp.**	97±7 90-103 2	303±42 250-387 3	67±3 64-70 2	199±50 131-296 3	210 --- 1	30 ---
Smelts **Osmeridae spp.**	156±25 80-214 5	---	317±200 50-750 3	245±55 190-680 3	112±13 86-137 4	24 --- 1
Snails **Mixed species**	91±18 68-146 4	179 --- 1	---	---	---	---
Snake mackerels **Gempylidae spp.**	101±21 80-122 2	360 --- 1	70 --- 1	270 --- 1	---	59±19 40-78 2
Snappers **Lutjanidae spp.**	78±10 33-150 11	285±27 125-373 9	32±5 14-65 10	248±42 120-527 10	220 --- 1	24±4 20-28 2
Snooks **Centropomidae spp.**	71±3 66-80 4	308±63 193-477 4	33±6 14-54 8	191±31 89-400 10	---	25±5 20-30 2
Slimys and Soapies **Leinognathidae spp.**	146±16 130-162 2	344±65 218-437 3	42±6 19-52 6	272±79 148-554 5	---	---
Soles **Pleuronectidae spp.**	85±4 56-163 27	344±12 253-475 20	21±6 12-32 3	249±98 105-436 3	---	31 --- 1
Soles **Soleidae spp.**	80 --- 1	220±28 168-262 3	29±7 18-47 4	271±27 230-349 4	80 --- 1	25±3 20-30 3
Spadefishes **Ephippidae spp.**	94±4 90-98 2	331±39 292-370 2	61±9 37-74 4	223±20 191-280 4	---	40 --- 1
Squids **Mixed species**	176 --- 1	275±20 246-313 3	50±11 10-109 8	221±41 153-420 5	---	20 --- 1
Squirellfishes **Holocentridae spp.**	70 --- 1	---	---	---	---	---

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Stargazers Uranoscopidae spp.	---	---	---	---	357 --- 1	---
Sturgeons Acipenseridae spp.	---	---	---	---	466 --- 1	---
Suckers Catostomidae spp.	53±1 50-59 8	313±9 292-344 7	15 --- 1	165 --- 1	---	---
Sunfishes Centrarchidae spp.	116 --- 1	---	---	---	---	38 --- 1
Surgeonfishes Acanthuridae spp.	91±31 60-122 2	327±111 192-546 3	38±12 21-45 4	324±90 169-503 4	---	---
Swordfishes Xipiidae spp.	102 --- 1	342 --- 1	13 --- 1	228 --- 1	130 --- 1	---
Tarpons Elopidae spp.	82±0 82-82 2	426±66 360-491 2	66±9 54-92 4	211±28 113-263 5	---	---
Therapons Theraponidae spp.	83 --- 1	345±129 216-474 2	48±4 40-59 4	280±78 193-435 3	---	---
Threadfins Polynemidae spp.	---	---	67±25 10-117 6	214±33 148-398 7	---	---
Tilefishes Branchiostegidae spp.	---	---	40 --- 1	217 --- 1	---	---
Tonguefishes Cynoglossidae spp.	---	489 --- 1	29 --- 1	164 --- 1	---	---
Triggerfishes Balistidae spp.	50±20 30-70 2	265±75 190-340 2	35±5 30-40 2	130±0 130-130 2	---	25±5 20-30 2
Trout, cisco Salmonidae spp.	108±29 38-320 9	329±19 280-358 4	12 --- 1	206±54 152-260 2	---	17 --- 1
Trout, grayling *Thymallus arcticus*	---	---	---	142±41 101-182 2	---	---
Trout, salmon Salmonidae spp.	56±2 24-127 88	340±92 139-500 80	82±21 8-249 18	268±17 125-360 18	29 --- 1	52±11 15-99 10
Trouts Salmonidae spp.	43±8 26-77 6	395±30 227-555 13	23±8 12-38 3	221±23 152-315 8	100 --- 1	29±3 26-32 2
Trout, whitefish Salmonidae spp.	52±1 52-53 3	307±10 297-317 2	---	310 --- 1	351 --- 1	---

(Table V-B-6 Continued)

	mg/100g					
	Na	K	Ca	P	Cl	Mg
Tunas	66±5	363±7	30±8	348±44	162±39	50
Scombridae spp.	31-188	252-518	6-93	190-760	35-280	---
	44	42	12	17	5	1
Turbot	68		49	203		
Pleuronectidae spp.	---	---	---	---	---	---
	1		1	1		
Viperfish	150	250	51±8	118	112	29±0
Charliodontidae spp.	---	---	43-58	---	---	25-32
	1	1	2	1	1	2
Weevers		213		423	50	
Trachinidae spp.	---	---	---	---	---	---
		1		1	1	
Whale, sperm		360				
Physeter macrocephalus	---	---	---	---	---	---
		1				
Whelks		89±51	34	58		
Mixed species	---	38-140	---	---	---	---
		2	1	1		
Whiting	84±34	326±66	45±11	169±12		21±1
Sillaginidae spp.	50-118	260-457	16-71	130-253	---	20-21
	2	3	5	5		2
Wrasses	50	390±32		432±69	83±12	---
Labridae spp.	---	358-422	---	388-615	50-100	
	1	2		3	4	

*Standard error of the mean.
**Range.
***The number of averages used.

GLOSSARY

Autolytic Enzyme: A bacterial enzyme located in the cell wall. It causes disintegration of the cell following injury or death.

Adductor muscle: A muscle that draws a part of the body toward the median axis. For example, the muscle that a clam uses to close its valves.

Biologically Available: Existing in a form that can be utilized by the body.

Bivalved: Having two valves, as the two "shells" of a clam.

Buoy: A float moored in water as a warning of danger or as a marker.

Carapace: A bony outer covering such as the fused plates of a turtle.

Chlorination: The addition of chlorine to water to reduce contamination by microbes.

Crustacean: A category of animals having jointed feet and mandibles, two pairs of antennae, and segmented bodies with a protective covering. Examples are crabs and lobsters.

Enzyme: An extremely complex protein molecule which is able to initate or control the rate of certain biological processes. There are many different types of enzymes in the body, which control digestion, food uptake by cells, cell metabolism, muscle activity, and many other functions.

Exoskeleton: The external supportive covering of certain animals that lack backbones and internal skeletons.

Fatty acid: Long carbon chain molecules with an organic acid at one end and hydrogen atoms attached to the remaining carbon atoms. Three essential fatty acids (linoleic, linolenic, and arachidonic acid) are not synthesized by humans and must be obtained in the diet.

Gills: The respiratory organism of water-breathing animals.

Lipid: Organic compounds often containing elements other than carbon, hydrogen, and oxygen--particularly phosphorus and nitrogen. These compounds are insoluble in water. They include fats and waxes.

Mantle: An enveloping layer, such as the external body wall lining the shell of many invertebrates.

Metabolism: The physical and chemical processes by which foodstuffs are synthesized into complex elements, complex substances are transformed into simple ones, and energy is made available for use by the organism.

Milts: The secretions of the testis of fishes.

Mollusca: A category of animals that includes snails, slugs, octupuses, squids, clams, mussels and oysters. Mollusks are characterized by a shell-secreting organ, a mantle, and a radula (a food-rasping organ located in the forward area of the mouth).

Molting: Shedding an outer covering as part of a periodic process of growth.

Munsell value: A numerical representation of color based on a standardized color scale.

Oxidation: A chemical reaction that increases the oxygen content of a compound.

Pasteurization: A process of heat treatment of food to destroy all organisms dangerous to health. Pasteurized food is normally heated at between 70° and 100° Celsius (160° - 212° Fahrenheit).

Plankton: Passively floating or weakly moving aquatic plants and animals, usually microscopic.

Polyunsaturates: Fats containing fatty acids having more than one unsaturated bond. An unsaturated bond is a chemical structure into which additional hydrogen can be incorporated. In general, polyunsaturated fats tend to be liquids of vegetative origin.

Rancidity: An oxidative deterioration in food fat whereby a typical off-odor and/or flavor is produced.

Regeneration: The replacement by an organism of tissues or organs which have been lost or severely injured.

Retort: Any closed vessel or other equipment used for the thermal sterilization of foods.

Spawning: Producing or depositing eggs or discharging sperm. Applied to aquatic animals.

Teleost: A class of finfish.

Titration: A method of analyzing the composition of a solution by adding known amounts of a standardized solution until a given reaction (color change, precipitation, or conductivity change) is produced.

Viscera: The organs within the cavities of the body of an organism.

Weir: A fence placed in a stream to catch or retain fish.

BIBLIOGRAPHY

Booth's Fish & Seafood Cook Book, The Pillsbury Company, 1970.

Burtis, Jean, Ellen H. Nagy, and Rose G. Kerr, *How to Cook Lobsters,* Test Kitchen Series No. 11, Fish and Wildlife Service, 1964.

Burtis, Jean and Rose G. Kerr, *How to Cook Shrimp*, Test Kitchen Series No. 7, Fish and Wildlife Service, 1964.

Fish and Shellfish for your Table, The North Carolina Agricultural Extension Service, Circular 465, Raleigh, 1965.

Fresh and Frozen Fish Buying Manual, U.S. Department of the Interior, Circular 20, Washington, 1961.

How to Eye and Buy Seafood, National Marine Fisheries Service, Washington, 1970.

Jarvis, Norman D., *Spiced and Pickled Seafoods*, revision of U.S. Fish and Wildlife Service, Research Report 18, pp. 146-164.

Keller, Dorothy M., Paula W. Lemmon, and Rose G. Kerr, *How to Cook Scallops*, Test Kitchen Series No. 13, Fish and Wildlife Service, 1959.

Kerr, Rose G. and Jean Burtis, *How to Cook Oysters*, Test Kitchen Series No. 3, Fish and Wildlife Service, 1964.

Lapedes, Daniel H., Ed., McGraw-Hill Dictionary of Life Sciences, McGraw-Hill Book Company, New York, 1976.

Let's Cook Fish! Fishery Market Development Series No. 8, United States Department of the Interior, Washington, 1976.

Nickleson II, Ranzell, and Don W. Steinbach. *Now that you've caught that fish... what are you going to do with it?* Texas A & M Sea Grant Program, 1976.

Osterhaug, Kathryn L. and Rose G. Kerr, *How to Cook Clams*, Test Kitchen Series No. 8, Fish and Wildlife Service, 1964.

Protection Through Inspection, U.S. Department of Commerce, Washington, 1974.

Robey, Dorothy M. and Rose G. Kerr, *How to Cook Crabs*, Test Kitchen Series No. 10, Fish and Wildlife Service, 1964.

Seafood Data Bank, National Marine Fisheries Service, Washington, 1974.

Seafood Information Packet, Maryland Seafood Marketing Authority, Annapolis.

Sidwell, Virginia D., et al., *Chemical and Nutritive Values of Several Fresh and Canned Finfish, Crustaceans and Mollusks. Part I: Proximate Composition, Calcium, and Phosphorus*, MFR Paper 1022, *Marine Fisheries Review*, December, 1973, pp. 16-19.

Sidwell, Virginia D., et al., *Composition of the Edible Portion of Raw (Fresh or Frozen) Crustaceans, Finfish, and Mollusks. I. Protein, Fat, Moisture, Ash, Carbohydrate, Energy Value, and Cholesterol*, MFR Paper 1043, *Marine Fisheries Reveiw*, March, 1974, pp. 21-35.

Sidwell, Virginia D., et al., *Composition of the Edible Portion of Raw (Fresh or Frozen) Crustaceans, Finfish, and Mollusks. II. Macroelements: Sodium Potassium, Chlorine, Calcium, Phosphorus, and Magnesium*, MFR Paper 1228, *Marine Fisheries Review*, January, 1977, pp. 1-11.

Stansby, Maurice E., *Industrial Fishery Technology*, Reinhold Publishing Corporation, New York, 1963.

Tips of Cooking Fish and Shellfish, U.S. Department of the Interior, Washington, 1958.

Tressler, Donald K. and James McW. Lemon, *Marine Products of Commerce*, Reinhold Publishing Corporation, New York, 1951.

AUDIO-VISUAL AIDS

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Films:

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Picking the Blue Crab (summer, 1978)
Filleting the Finfish (summer, 1978)
Shucking Oysters and Clams (fall, 1978)
Filleting and Cleaning Shad (winter, 1978-79)

Slide Series (with script):

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The above titles will be available both for sale and for rent. For rental of films, only, as they become available, write directly to the Film Library, Learning Resources, Patton Hall, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 24061. (See page for an ordering blank on *Picking the Blue Crab*.

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